VOLUME XXIII

NUMBER TWO

THE NATIONAL GEOGRAPHIC MAGAZINE

FEBRUARY, 1912

CONTENTS

Bird's-eye View of the Panama Canal, 9x18 inches, in Colors — Supplement

Adam's Second Eden — ELIZA RUHAMAH SCIDMORE
With 60 Full-page Illustrations

The Pearl Fisheries of Ceylon — HUGH M. SMITH
With 12 Illustrations

The Panama Canal — WILLIAM JOSEPH SHOWALTER

The Discovery of the South Pole
With Map

National Geographic Society Notes

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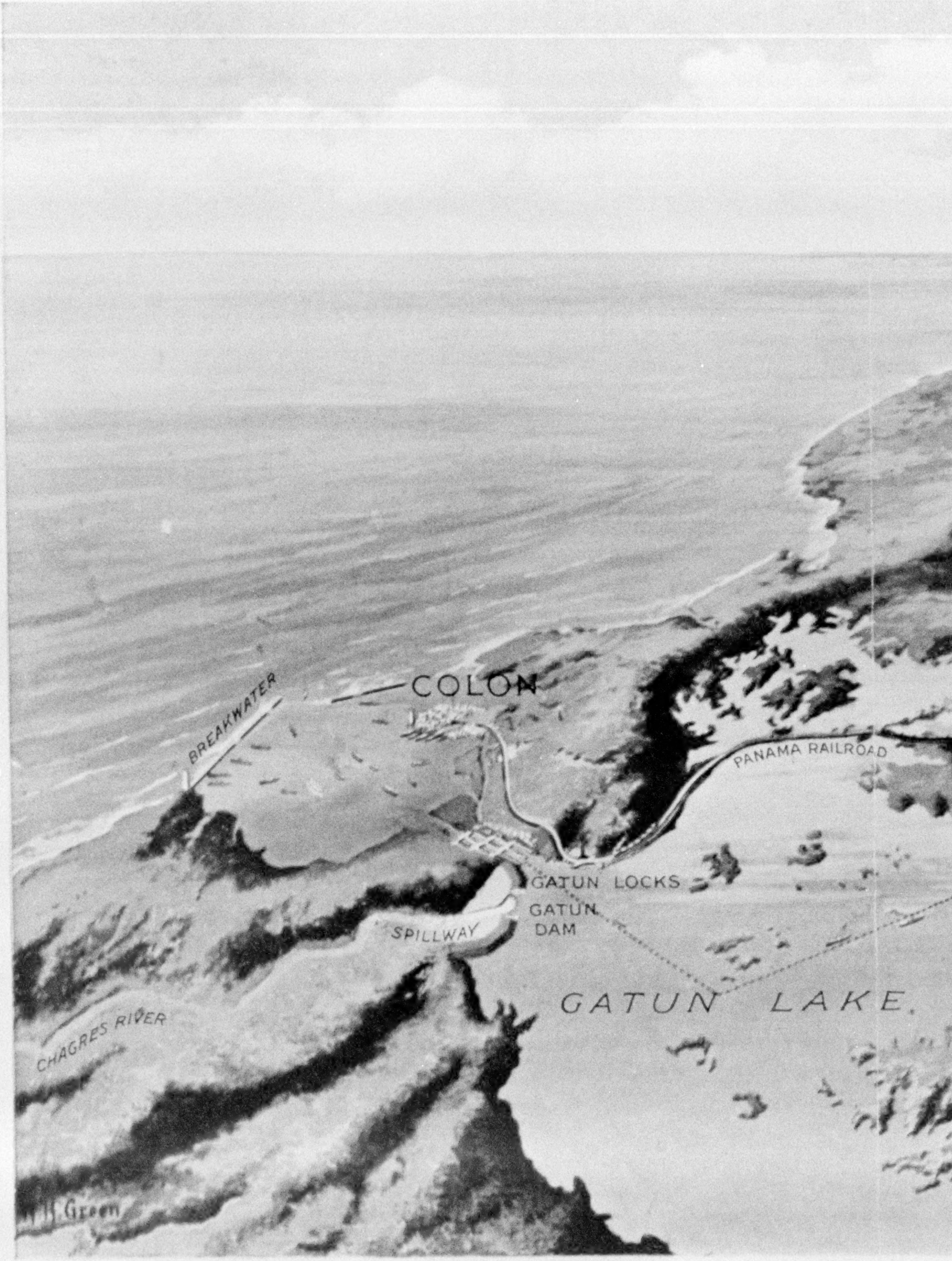
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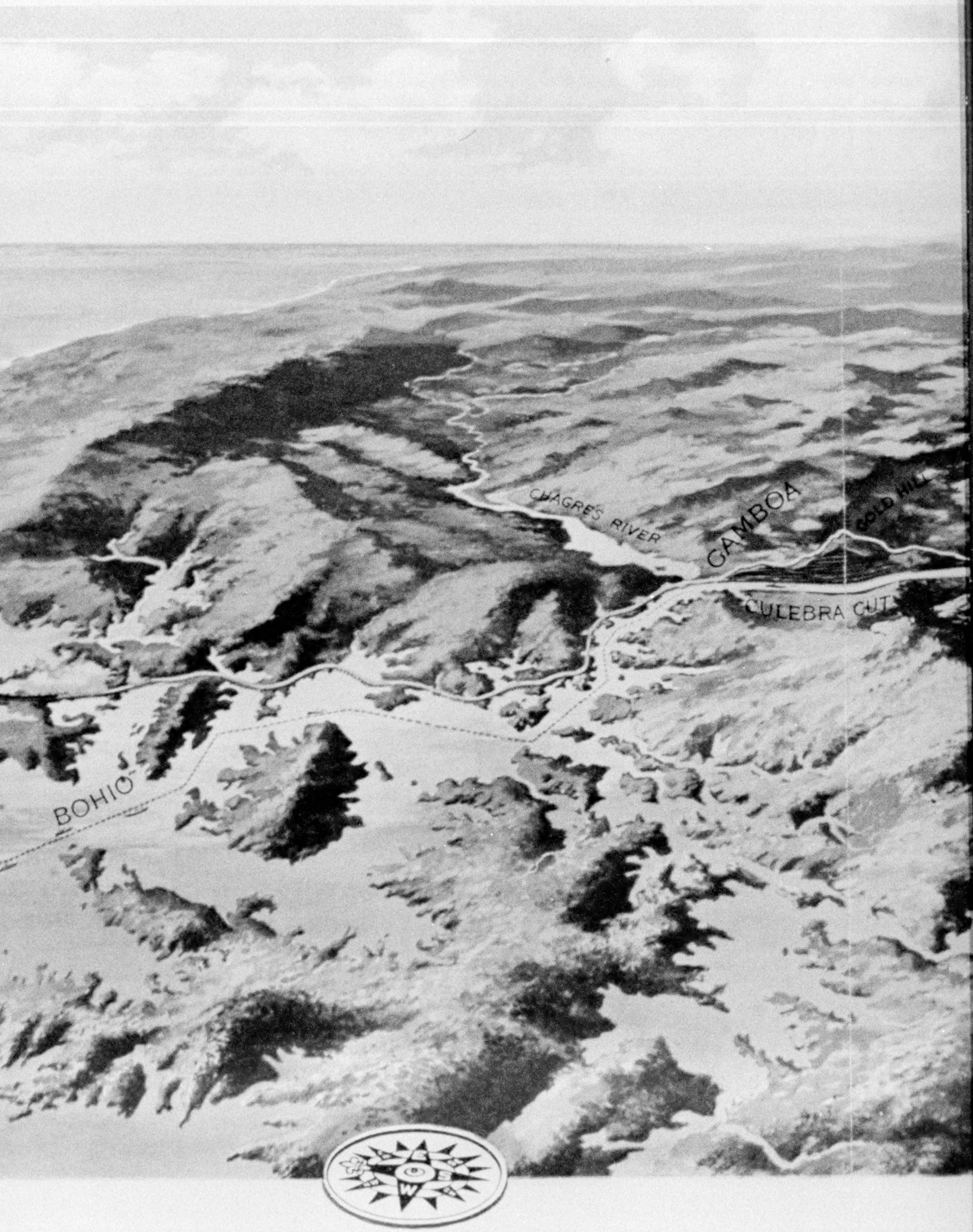
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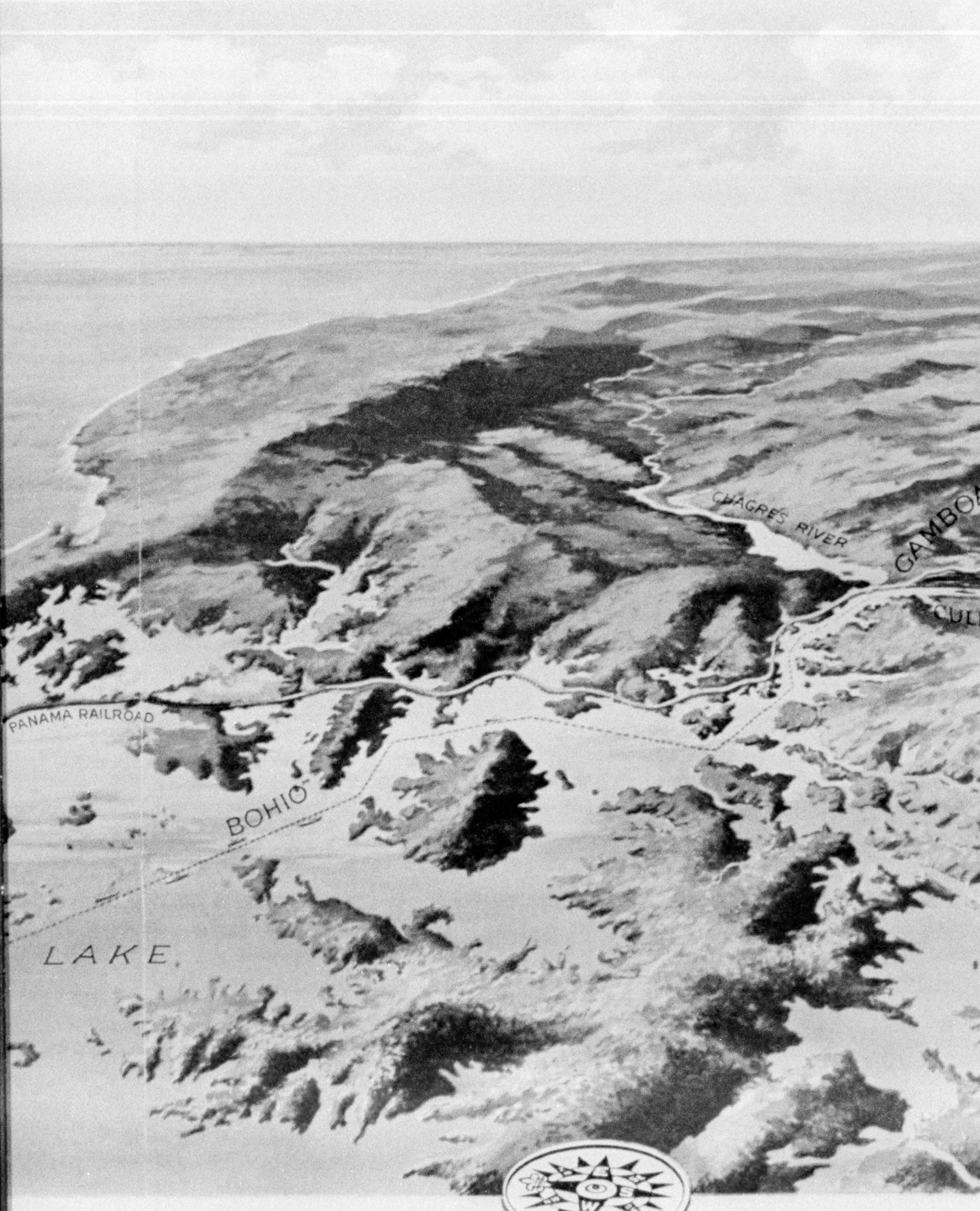
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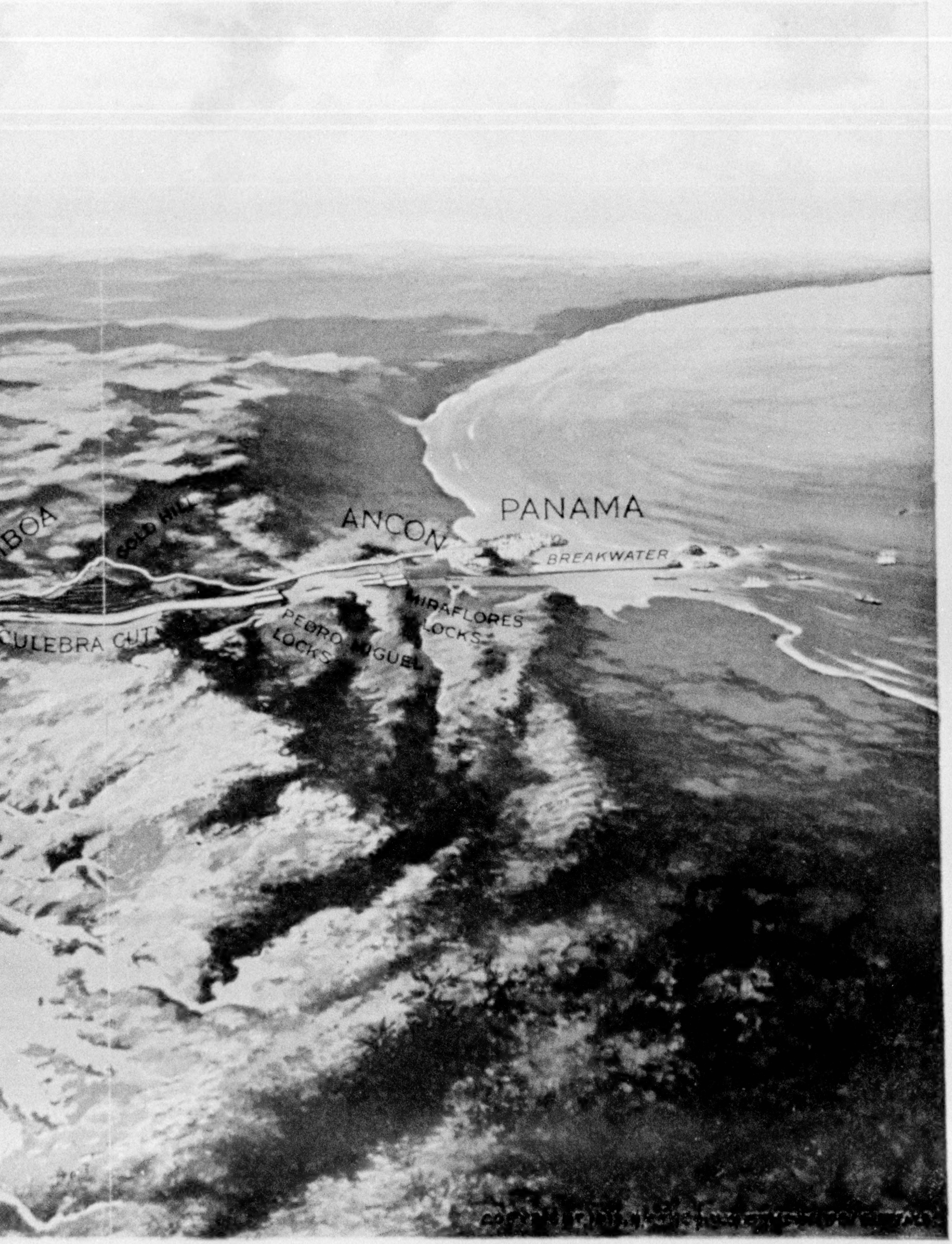
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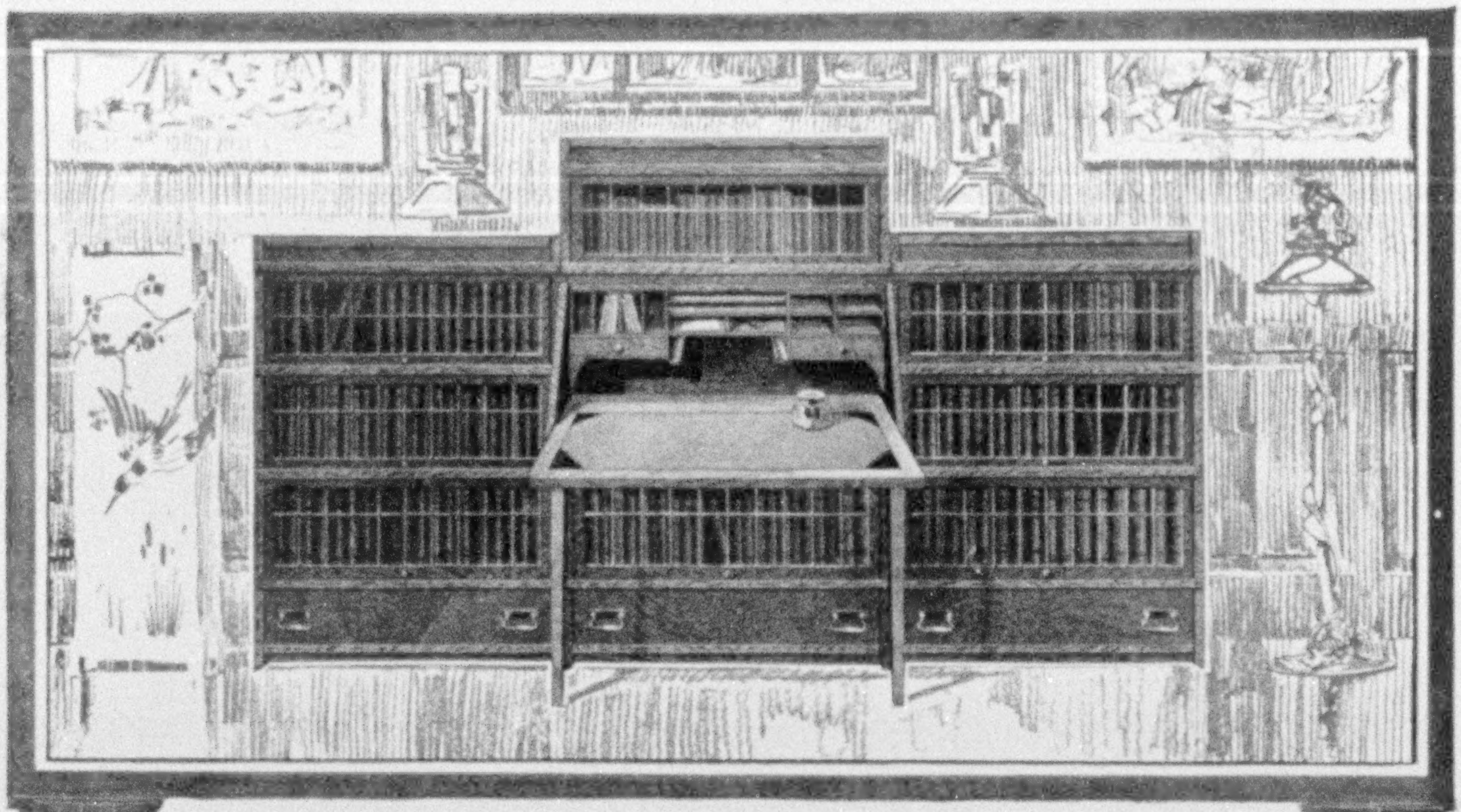

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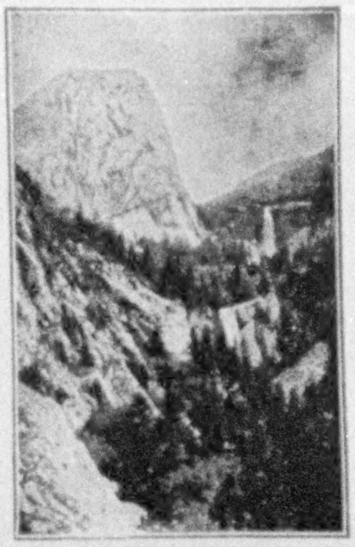

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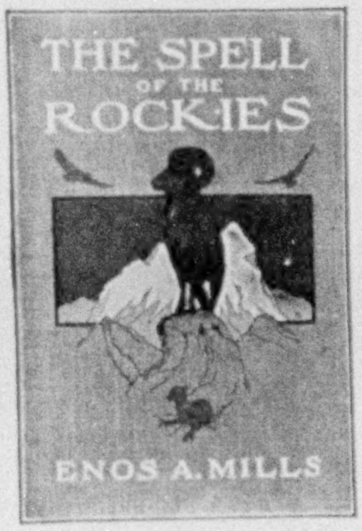

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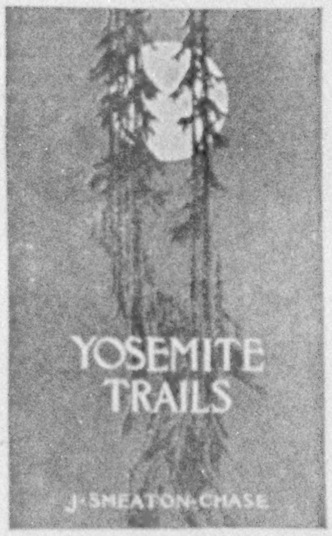

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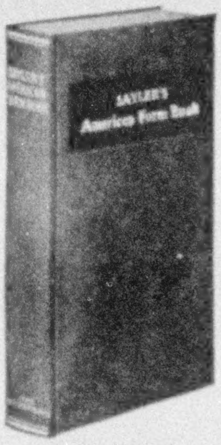

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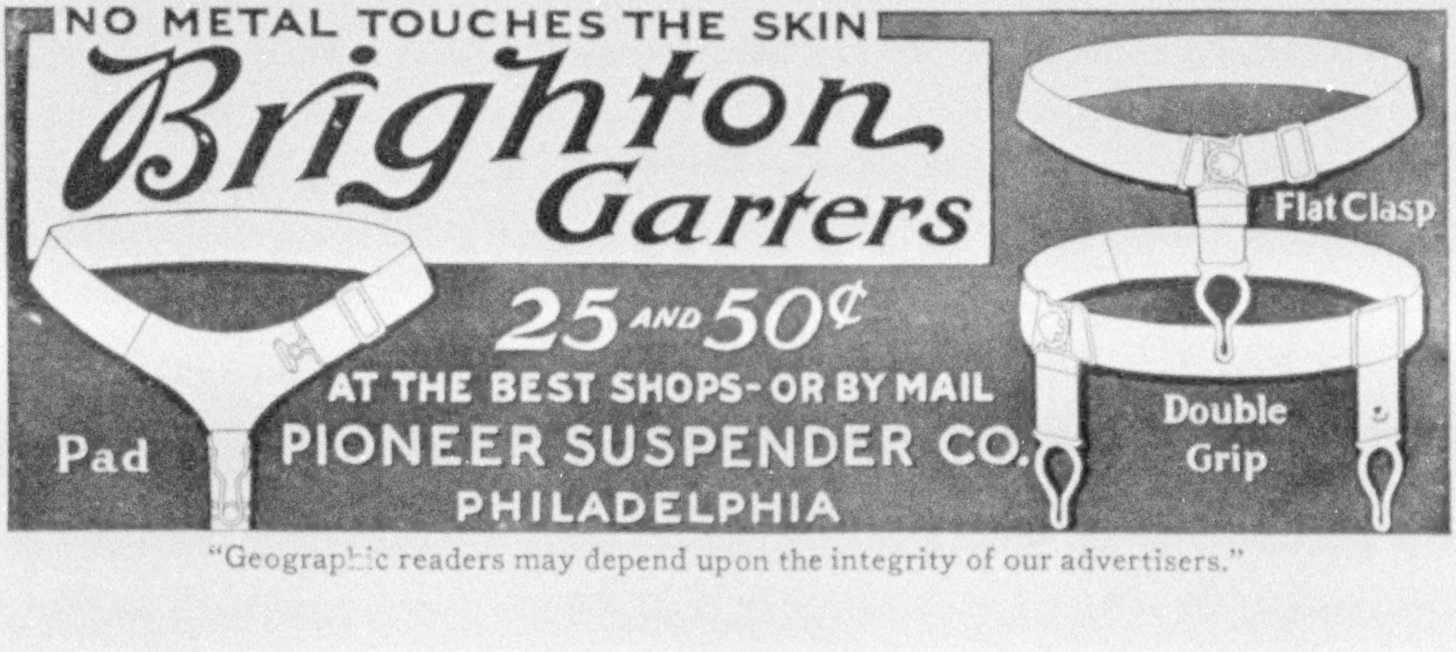

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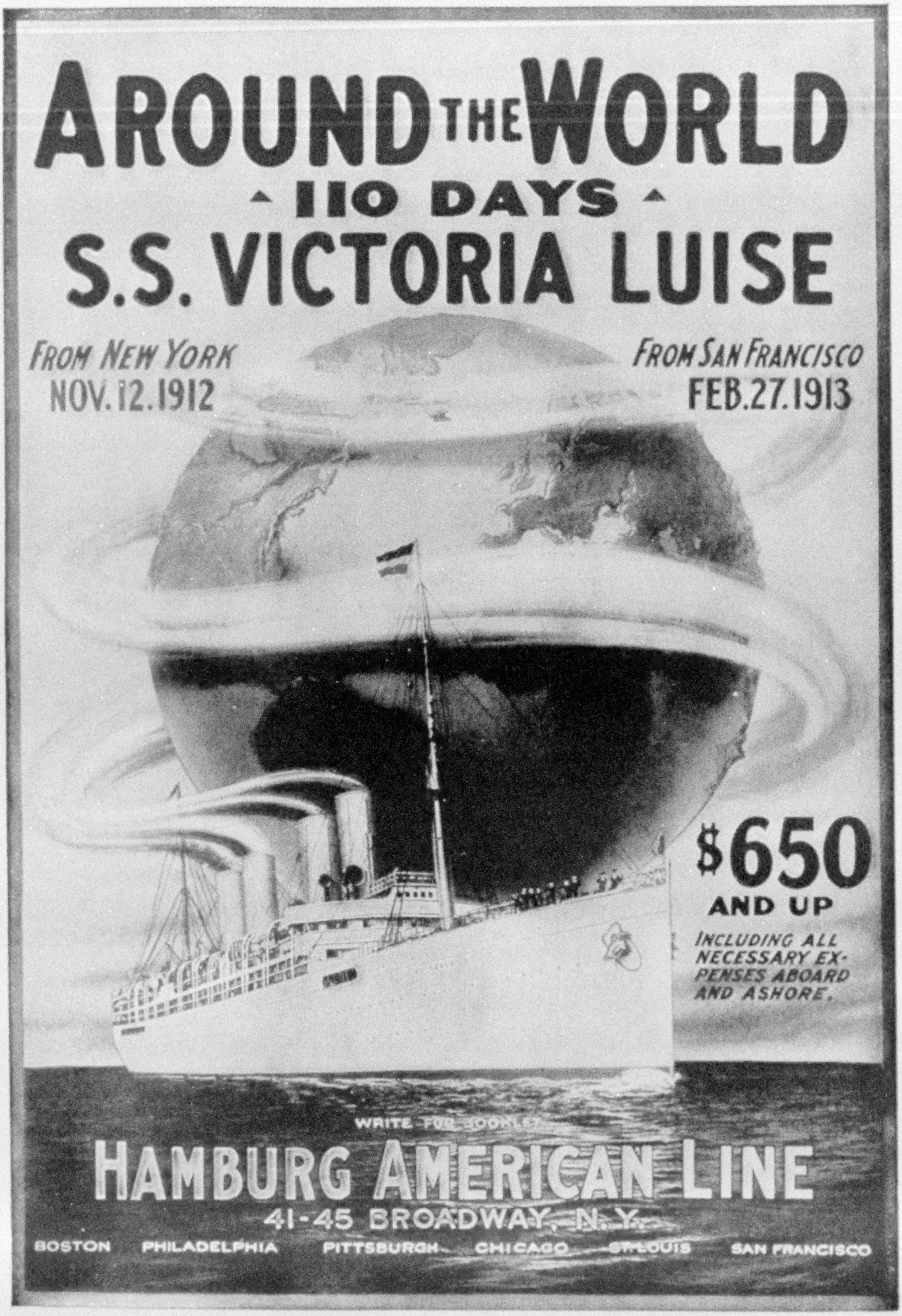

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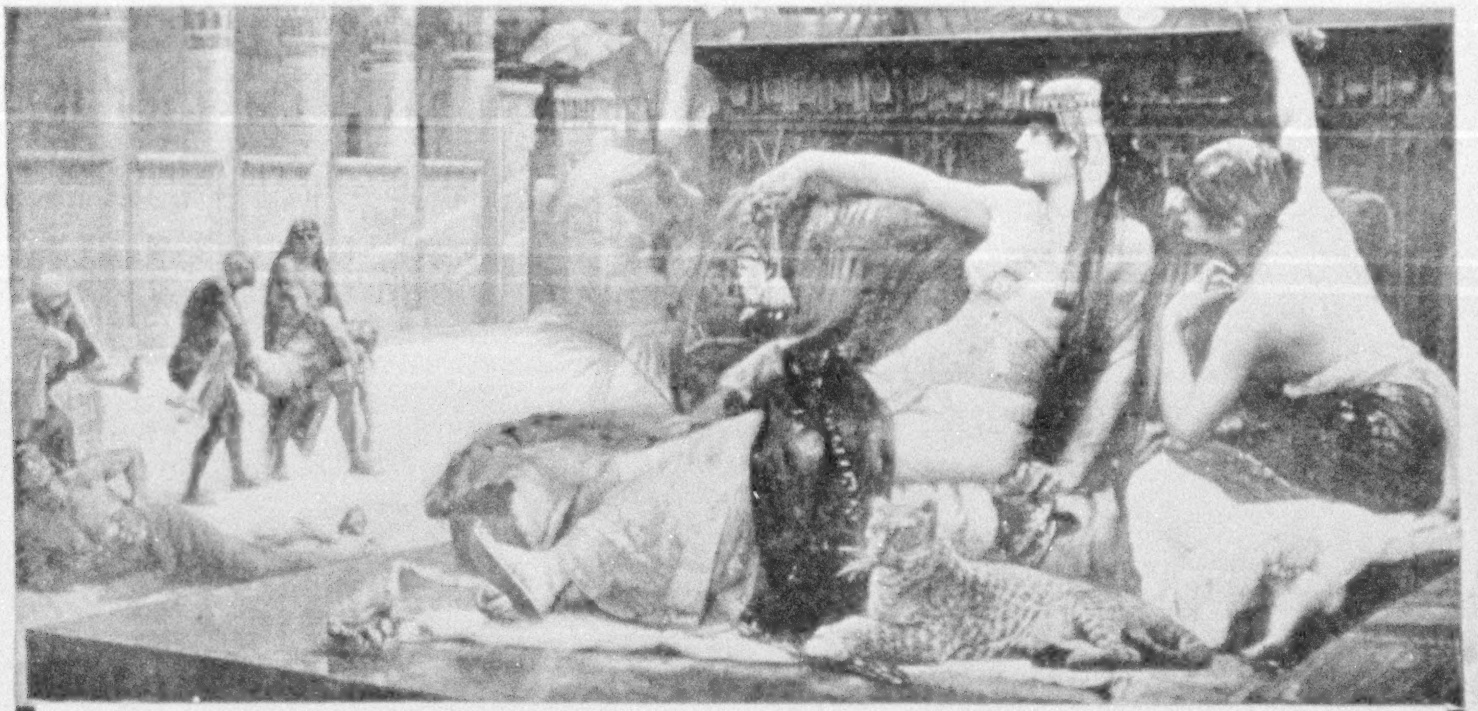

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VOL. XXIII, No. 2 WASHINGTON FEBRUARY, 1912

THE NATIONAL GEOGRAPHIC MAGAZINE

ADAM'S SECOND EDEN

BY ELIZA RUHAMAH SCIDMORE

AUTHOR OF "JAVA—THE GARDEN OF THE EAST," "CHINA—THE LONG-LIVED EMPIRE," "WINTER INDIA," "JINRIKISHA DAYS IN JAPAN," ETC.

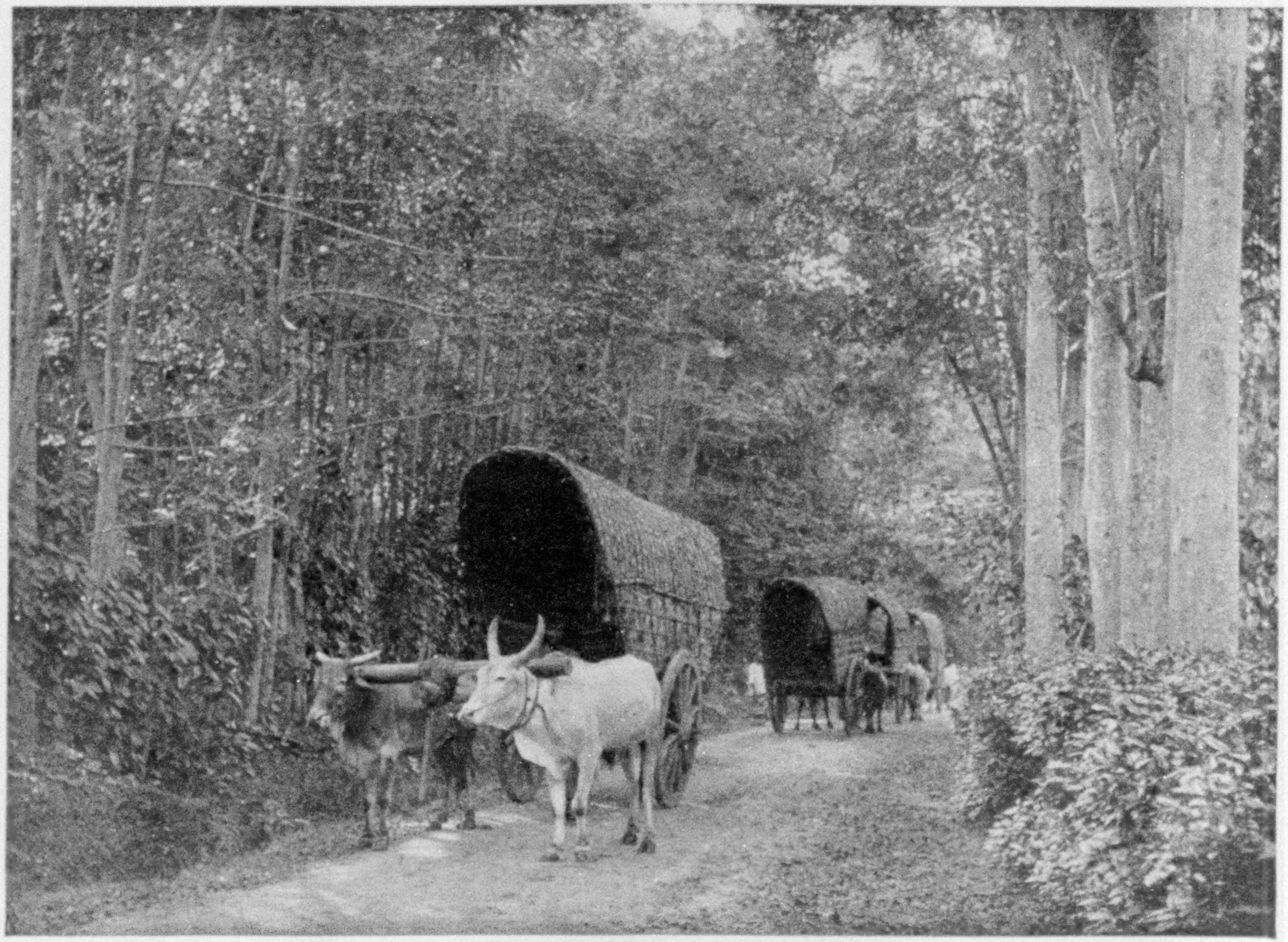
CEYLON, the second Paradise, to which Adam fled after the expulsion, is literally one of the "summer isles of Eden lying in dark purple spheres of sea." Its softly blue mountains rise up out of the sea and belt themselves round with a broad band of level, green lowlands, where crooked cocoa palms, with trunks aslant at every angle, reel on swollen feet to the very beaches of yellow sand and bend their tufted heads to the voice of the sea, without which, it is said, they cannot live.

One always comes into Colombo harbor at daybreak, from whichever quarter the ship sails, and the dawn's freshness adds to the beauty of the setting and the clearness of every impression. Native catamarans, rude dugout canoes, each with an outrigger log which keeps it level or afloat in any sea or surf, pursue each mail steamer into the protected harbor, and brown boys with their innumerable black and yellow brothers are ready to dive for coins until their cheeks bulge with the accumulated small change of all nations.

Then Arab boys climb straight up the iron side of the ship with Europe's and Colombo's latest newspapers, and a steam-launch puts one beside the model landing-stage, where England's might in the person of a pink-faced British constable maintains law and order in the crowds of chattering natives of every hue, clad in cottons of every strong color that can dare the tropic sun.

A hard red roadway stretches away in far perspective, lined with white buildings, and the tableaux and motion pictures begin. Big thatched carts drawn by splendid white bullocks and little carts drawn by tiny white bullocks, that trot like ponies, transport the brown folk and their families off to their quarter of the town, and, if the deep verandas of the "G. O. H." (Grand Oriental Hotel) beside the jetty do not engulf one on the spot, the most modern jinrikishas, with fat pneumatic tires, waft one across the neck of land to the other great hotel and center of interest at the edge of the sea. The *pad-pad-pad* of the runner's bare feet on the hard red roads are the only sounds, and there is no more motion felt than in a floating balloon.

The jinrikisha speeds past the clock tower and the old fort and the new barracks over to the great greensward of Galle Face, where the blue, blue sea stretches away unbroken clear to the Antarctic Continent, and the long, lazy surf of the Indian Ocean rolls in soft,



BULLOCK CARTS ON A COUNTRY ROAD: CEYLON

"Big thatched carts drawn by splendid white bullocks and little carts drawn by tiny white bullocks, that trot like ponies, transport the brown folk and their families off to their quarter of the town."

creamy white lines over the bright yellow sands—up to the bright red road and the intense green grass.

Every ship stops for a day at Colombo for coal and water, mails, and fresh stores; and all the earth—from East and West, from the Indian mainland and from the antipodes—meet at these two great hotels for midday curry and afternoon tea. All British folk know these two inns by their initial letters only, and in hot countries no Briton exerts himself to their full syllables, using a shorthand language for all such proper names and titles throughout "the gorgeous East."

Deep, dark-eyed Sinhalese boys beseech one to buy picture post-cards, old postage stamps, and match-box labels; and bearded Sinhalese in tight petticoats and white jackets, a child's round comb set backwards on their heads, like a reversed coronet, offer pillow-laces and "chicken-work" muslins, and pass trade messages to dark-eyed women in décolleté white waists, with strings and strings of bead necklaces on their plump brown necks.

The Moorman, the Jew, the Arabo-Armenian, the Malay, the Hindu, and the Sinhalese jewel merchants and their touts beset and bewilder one with their insistence. "Please come my shop." "Please buy my shop." "Please see great sapphire." "I show you big emerald." "Buy the Ceylon moonstone, lady." "Mine are bluer than his, lady," says No. 6. "I only have the best stones in Ceylon," says No. 7. "Mine only have the trueness blueness," says No. 8. "Please buy; I am poor man, lady," says another, making pantomime of conveying rice grains to his mouth with his fingers.

If the victim escapes the besiegers on the veranda, he only runs into the alcoves of shops further down the hotel fronts, or the blocks of Indian, Burmese, Chinese, and Japanese shops in the blocks beyond. Every day he sees the tourist of simple faith tempted; sees him haggle and struggle and buy, without test or guarantee or any knowledge of his own, rubies and sapphires, cat's-eyes, alexandrites, and emeralds. In time the victim learns that their value is exactly that of cut glass.

If he sits at ease for a moment, snake charmers squat before him and produce their pets like hanks of yarn from such little round sewing-baskets as our grandmothers used, and soon rows of hooded cobras sit up and wave their heads to the squeaky bagpipe airs of their charmers. A slim boy doubles himself into a basket, ducks his head, and the lid is made fast with ropes and the elders thrust swords through and through the basket. The lid is lifted and the boy emerges smiling, while the next juggler plants a mango seed under a bit of cloth, and, when it has grown and pushed the cover high from the ground, one sees the plant with thick rustling leaves still mounting before one's eyes as the grower carefully caresses it.

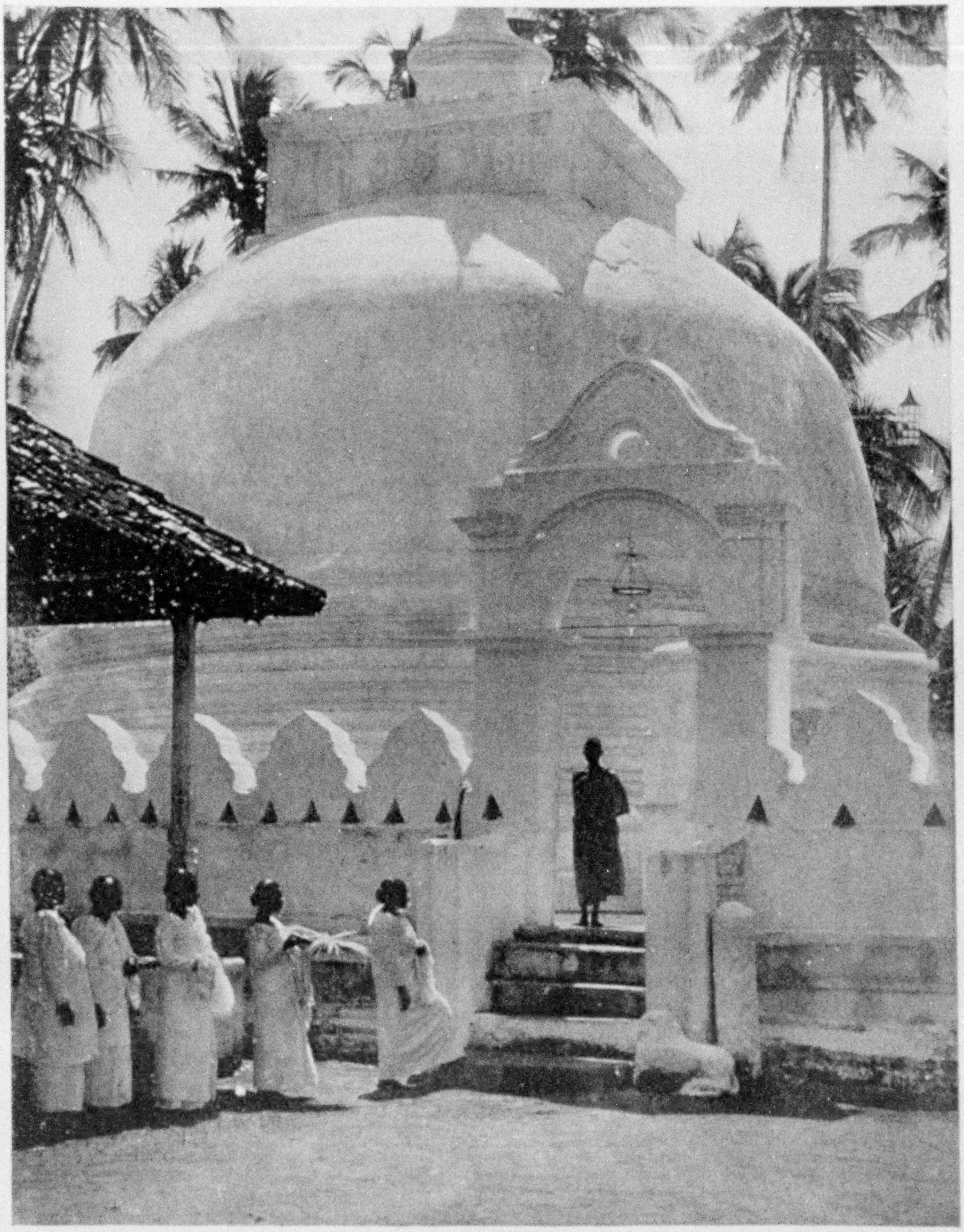
The native town of long hot streets, with noisy tram cars, lined with untidy, once-white, near-white houses, frescoed with betel-juice stains, is not picturesque; and for interesting drives one goes to the old Cinnamon Gardens and the new park, with its great banyan tree (see page 142), and sees the treasures of ancient art, the jewels, and the weapons at the museum. He drives or takes train for seven miles along shore to Mt. Lavinia, once the marine villa of the governors, then the home of Arabi Pasha, the Egyptian political prisoner, and now a favorite hotel.

In leafy suburbs there are dazzling white dagobas, or reliquaries, and flower-scented temples, where the Buddhist priests wear the same yellow robes, with bared shoulder, and teach the same pure tenets as when Asoka, the Indian Emperor, sent his son and daughter as missionaries to convert the island people. Priests come from other Buddhist countries to study the southern version of the creed at the Oriental College in Colombo.

In the early days of Portuguese and Dutch trade only the ports of Colombo, Galle, Jaffna, Trincomalee, and Battacoloa were known to Europeans, the fierce Sinhalese chiefs holding the hill country against all invasion. When the English drove the Dutch out, in 1796, they soon

NEGOMBO CANAL, MADE BY THE DUTCH, 23 MILES IN LENGTH, CONNECTING NEGOMBO AND COLOMBO

XUM



BUDDHIST TEMPLE AND DAGOBA, WITH SINHALESE NUNS AND PRIEST

"In leafy suburbs there are dazzling white dagobas, or reliquaries, and flower-scented temples, where the Buddhist priests wear the same yellow robes, with bared shoulder, and teach the same pure tenets as when Asoka, the Indian Emperor, sent his son and daughter as missionaries to convert the island people."

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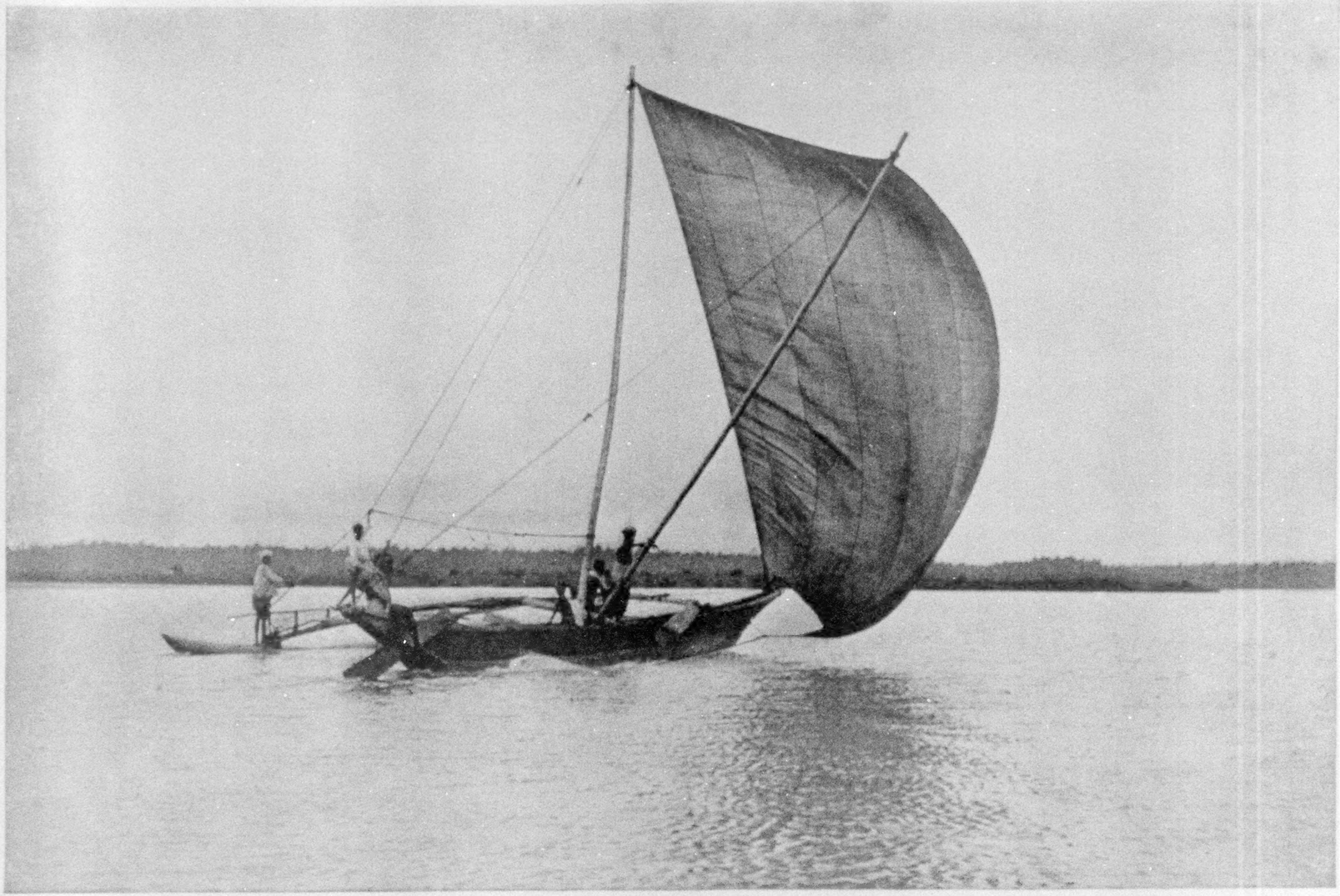
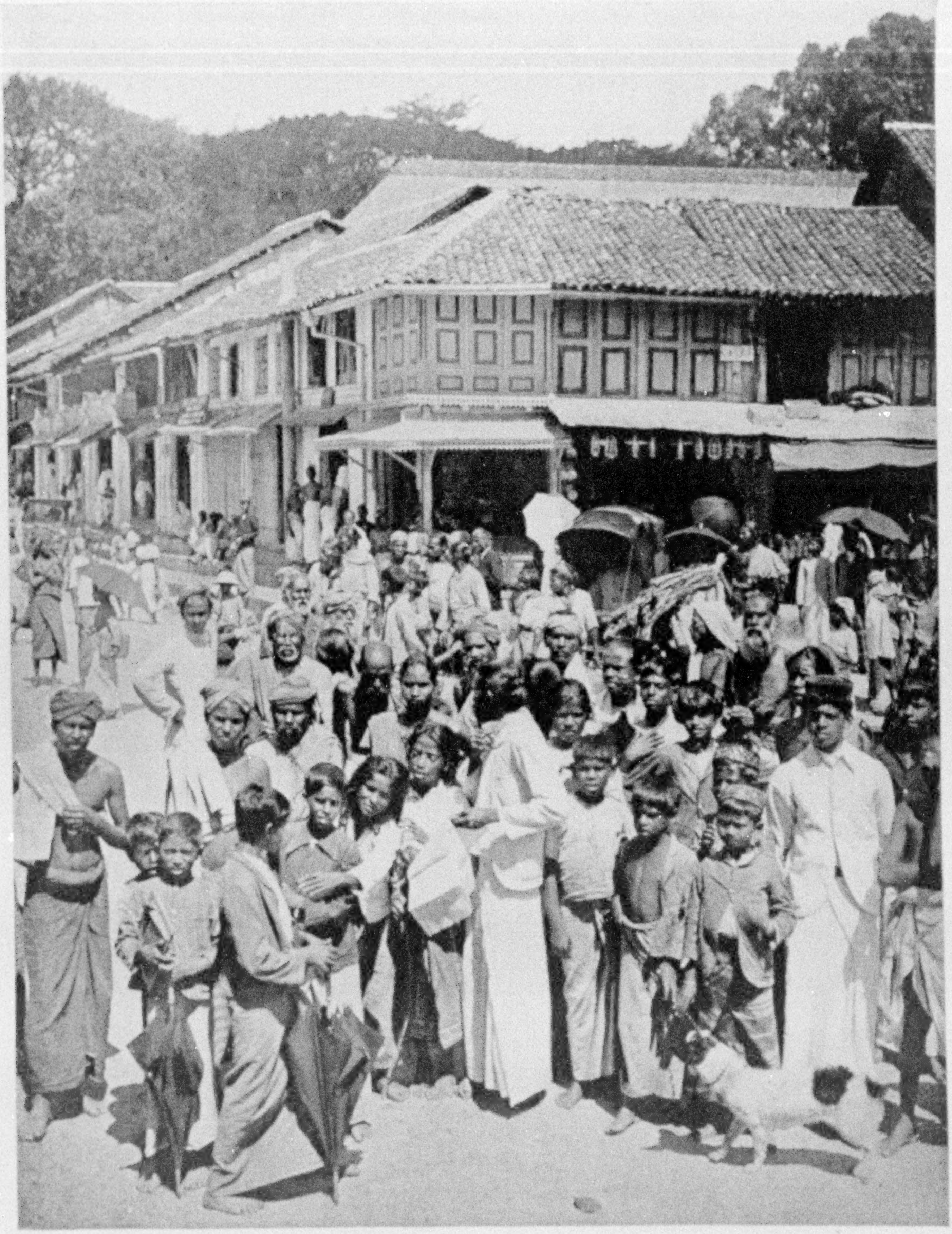


Photo from Dr. Alexander Graham Bell

OUTRIGGER CANOE

The outrigger is always kept to windward and the canoe sailed either end first. When strong wind blows one or more men sit on outrigger, as in this illustration



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STREET SCENE IN KANDY, CEYLON

"The Sinhalese men, in their straight tight comboys, or skirts, of bright cotton stuffs, look as if the populace were all entered for a sack race" (see page 115)

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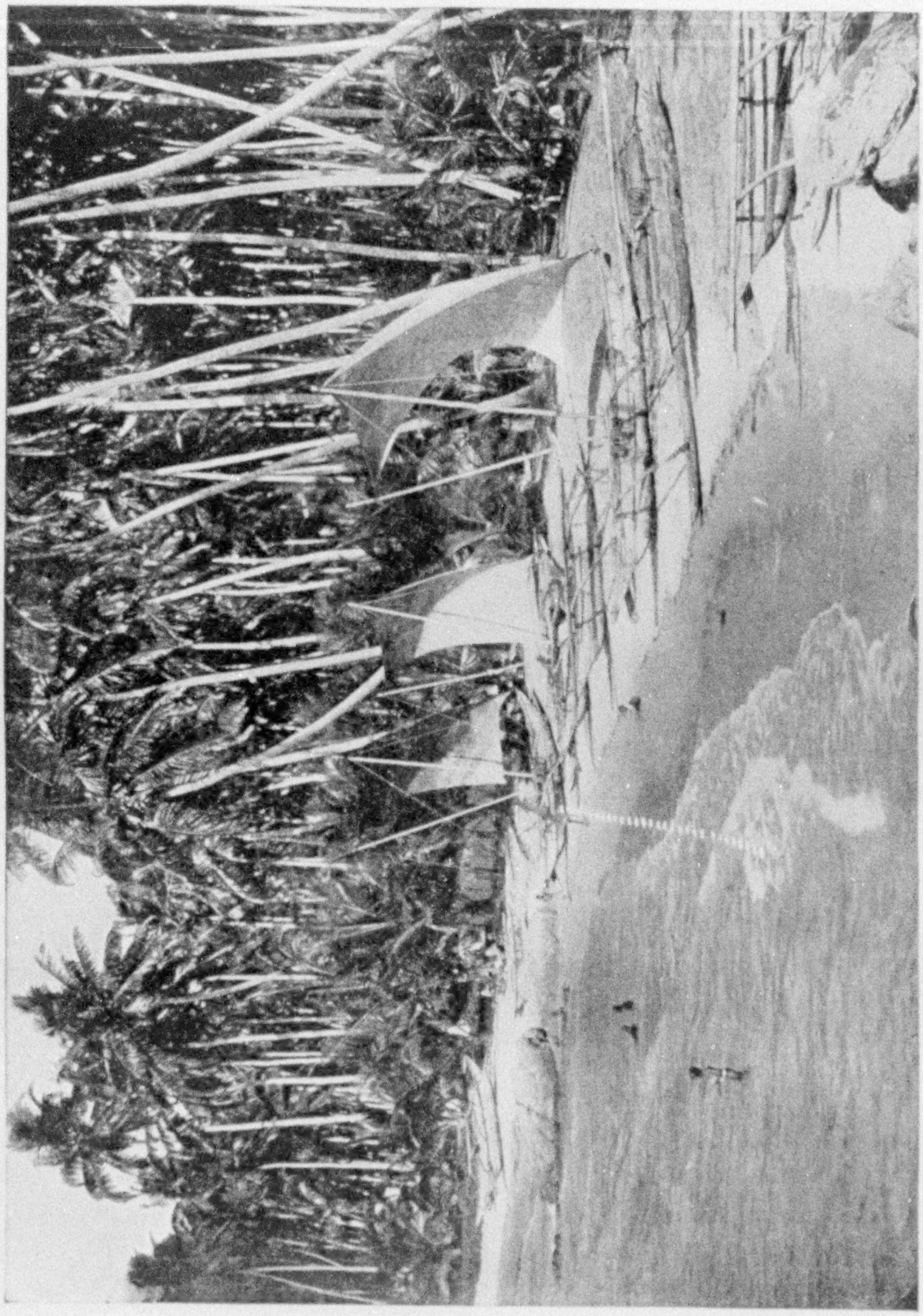

OUTRIGGER CANOES ON SEA BEACH; MOUNT LAVINIA, COLOMBO; COCOANUT PALMS AT THE EDGE OF THE SEA

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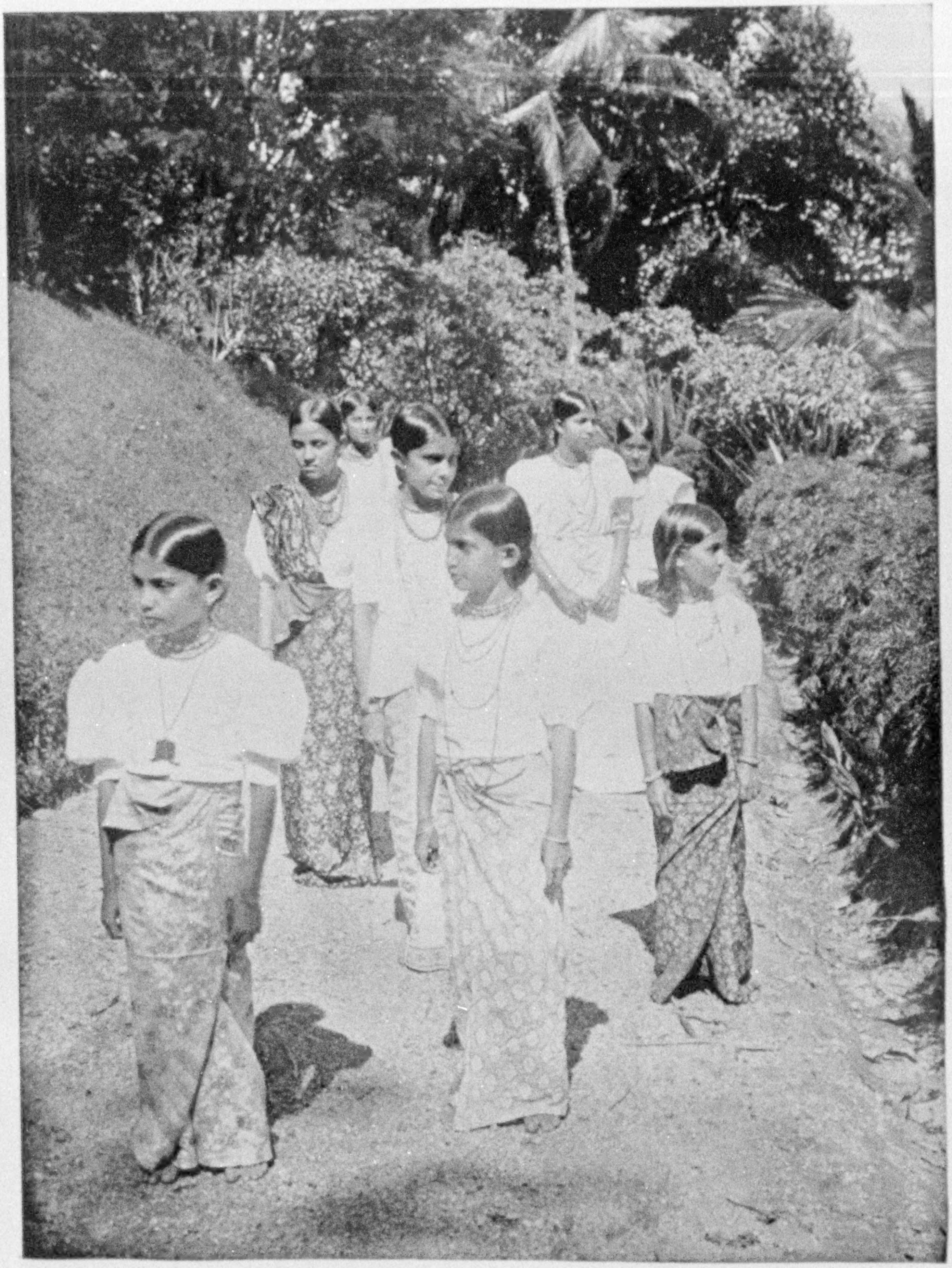

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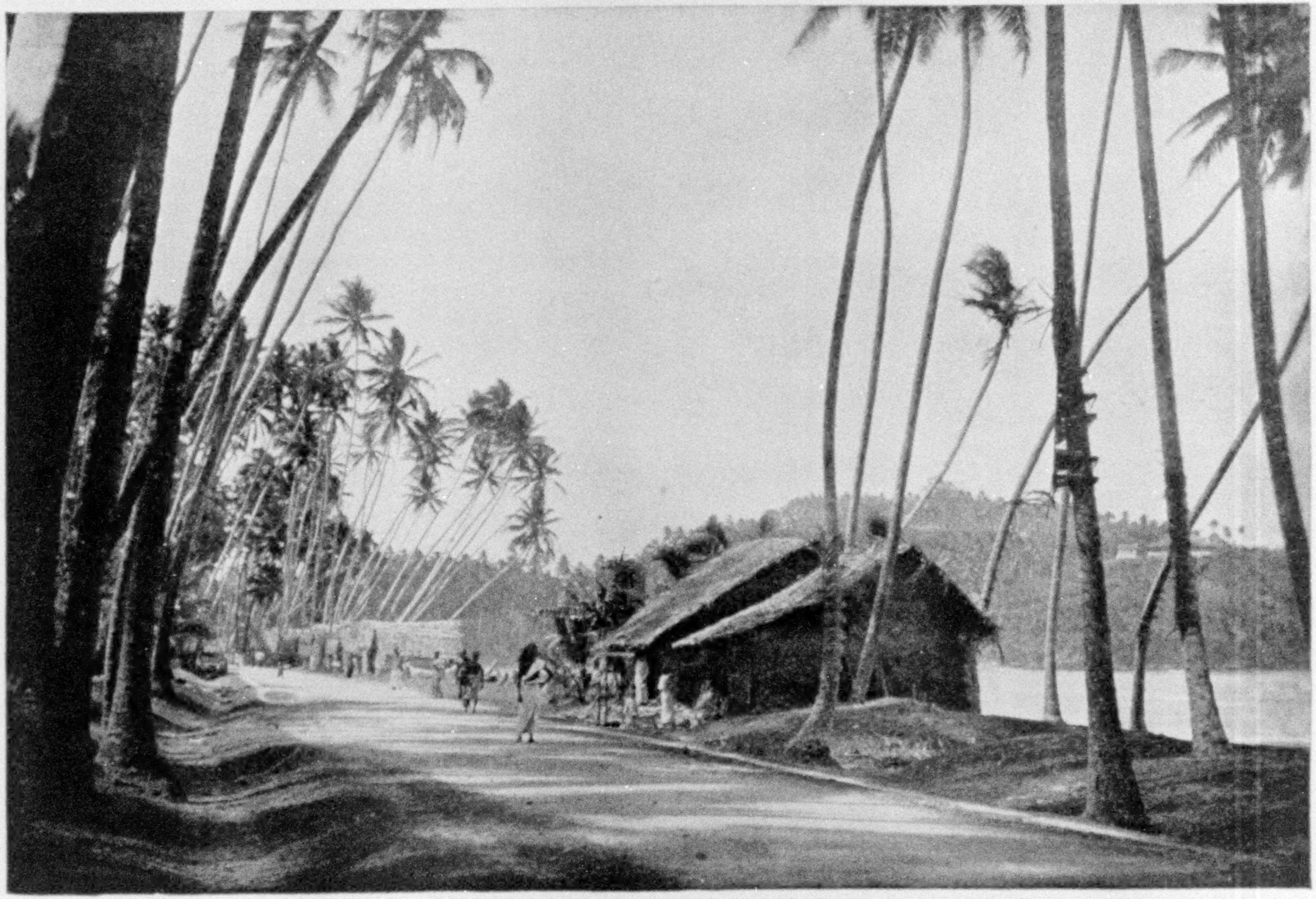
SINHALESE GIRLS AND WOMEN; KANDYAN JACKETS

Note the wonderful luster of the hair. The Sinhalese women, with their brilliant eyes, nice teeth, gentle manners and smiles, are most attractive (see page 117)



SHORE ROAD NEAR COLOMBO, BORDERED WITH COCOA PALMS pushed their way to the hills and took Kandy, where the native kings and princes had lived in an earthly paradise for more than four centuries, their palaces and temples having strange European resemblances because built by Portuguese prisoners of war. (For map of Ceylon see elsewhere in this number.)

The railway climbs the 75 miles from Colombo to Kandy, and rises 1,680 feet above the sea in three hours, and the transition from palmy suburbs and steaming cocoanut plains to the cool, tea-covered hills is as complete as agreeable. White station-houses are hung over with blooming vines and hedged with tall crotons, hibiscus, oleander, and lantana, and the chattering, good-humored people crowd off and on the trains, buy green cocoanuts to drink and betel nut to chew, and make travel a joyous holiday affair.

One traverses an endless level plain, where vast plantations of cocoa palms and miles of banana farms supply those first necessities of life to the Colombo markets. Down in this low country is the Heneratgoda botanical experiment station, where several varieties of rubber were tested 35 years ago. Since then the planters have taken up rubber culture with such energy that rubber, which ranked after tea, cinchona, and cocoa products, is now first, and may soon equal Brazil's record.

A rubber exhibition was held in Colombo in 1907 to stimulate planters' interest, and a first rubber auction in 1910, when 185,000 acres stood planted to rubber, with 55,000 acres in bearing. Since that year twice as many acres have been planted to Para rubber, tea and coffee bushes have been uprooted to make place for *Ficus elastica,* and in 1911 the export of 4,064,180 pounds of rubber doubled the output of the preceding year.

The great boom in rubber and the wild speculation in rubber shares in 1909 and 1910 sent innumerable investors to Ceylon to look over their spasmodically acquired properties, which, added to an unusual flock of tourists, tested the hotels of the island far beyond their capacity.

KANDY, THE CAPITAL OF EARTH'S PARADISE

Fifty miles out of Colombo the train begins to climb at a gradient of 1 foot in each 45, and in the next 12 miles the whole rise of 1,680 feet is accomplished, the air growing cooler each moment and the view ranging further and further out across valleys of terraced rice fields and hills striped with tea bushes.

Kandy is rightly the capital of the first earthly paradise under the English crown, a place so ideally beautiful and picturesque as to seem but a series of drop curtains. The heart of the town is the great stone walled tank, or artificial lake, which is encircled by a road shaded by magnificent, overarching trees, and along that road by day and night passes a panorama of native life that continually fascinates one. Lean brown priests from the monastery on one side of the lake are continually passing around to the Temple of the Tooth on the opposite shore, swathed in graceful yellow draperies, one shoulder bared and the hand holding a scoop of talipot palm leaf or a yellow umbrella to ward off rain or sun.

The Sinhalese men, in their straight, tight comboys, or skirts, of bright cotton stuffs, look as if the populace were all entered for a sack race; but this hobble skirt is as old as the dhoti of India, the sarong of Java and Malay countries, and it is so suited to the life and the climate that for centuries to come they will continue to wrap themselves tightly in plaid table-cloths and walk with difficult steps. The European white jacket and their own round tortoise-shell comb are worn by all Sinhalese men above the coolie class (see page 111).

The sooty black Tamils, who inhabit the fertile lowlands at the north end of Ceylon, and who come over from the Indian mainland by thousands to work on the plantations, are given to bright red and white draperies and turbans, and their women folk and tiny children are loaded with silver jewelry.

The Arabs and Moormen run to orange and to paids of red and yellow, so that everywhere, in the dazzling sun-

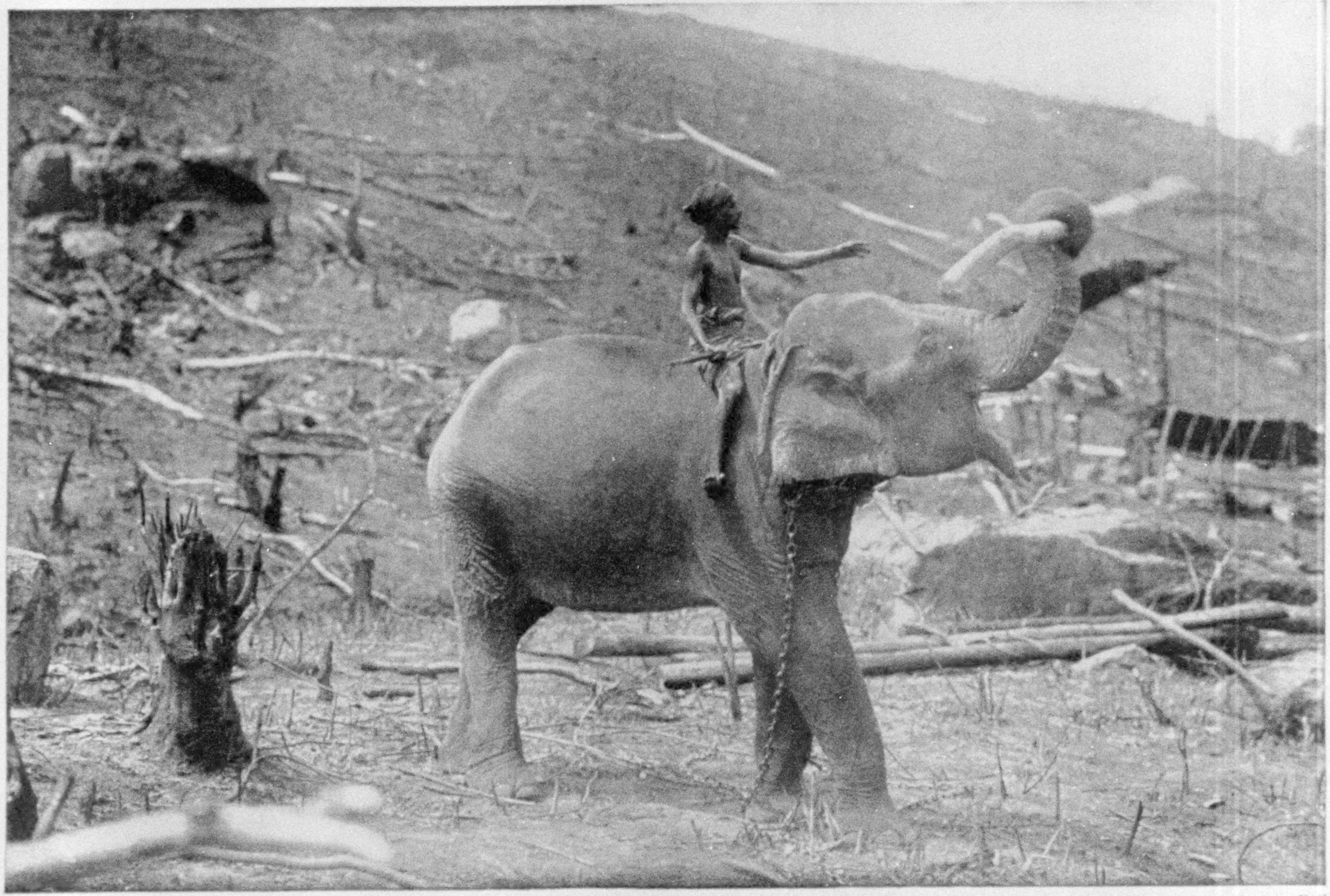


Photo from Dr. Alexander Graham Bell

ELEPHANT CLEARING LAND

shine and against the intense green foliage, one has moving pictures of color and light.

The Sinhalese women, with their brilliant eyes, nice teeth, gentle manners and smiles, are most attractive, and with the tight comboy they wear a tight-fitting basque, lace-bordered and décolleté, evidently of Dutch ancestry, which gives them a festive dinner-party air from sunrise to midnight. They wear necklaces by the dozen, gold beads for first choice, or beads that look like gold, and Venetian glass beads like unto all the gems that go well with bronze skins (p. 113).

It is the Tamil women who are loaded with nose rings and anklets, with rings on their fingers and rings on their toes. The Tamil dancing girls, loaded with real jewels, are matched by the Tamil pickers in the tea fields in tinsel and brass and glass gewgaws.

THE SACRED TOOTH

Chief object of interest at Kandy is the temple or palace of the Sacred Tooth, a relic of the body of the Buddha, which, after many wanderings in India, was sent to Ceylon for safe-keeping early in the 4th century. It was the prize of many wars, and once carried off by marauding Malabars, was recaptured and brought back to Ceylon in the 15th century. The Portuguese seized the tooth in the 16th century, took it to Goa, burned it, pounded the fragments in a mortar, and scattered the dust to the winds from a boat at sea.

That tooth ceased to exist, but the king had a new one made of ivory, large and strong, 20 times the size of any tooth any mortal saint ever had in his head, and built this Dalada Malagawa, or Palace of the Sacred Tooth, up in the hills, where neither marauding Tamils nor white buccaneers could get the molar away. Again and again, as wars were waged with Portuguese, Dutch, and English, the tooth was spirited from its palace and hidden, but since 1815 it has reposed in peace and safety under the British flag. It is taken out once a year, at the time of the great festival and elephant parade at the full moon of August, and is shown to crown princes and visiting potentates with great ceremony.

There is an imposing white entrance beside the lake, and from the first drumbeat at sunrise until the last service at sunset, one sees priests and people crossing the bridged moat and disappearing in the white archway. A cloister surrounds the large stone-paved court which holds the real shrine, a two-story building lavishly carved and gilded and surrounded as with a picket fence with spiked irons for the votive candles. Trays and baskets of flowers overflow at the entrance, where the flower-sellers sit all day disposing of their heavily scented jasmin, frangipanni, gardenia, and oleander garlands and loose blossoms.

IMMENSE STORES OF JEWELS

The worshiper, having cleansed heart and hands and feet at a fountain in a corner of the cloister, brings his candles and his trays of flowers and waits until the priests swing open the heavy silver doors, set in a triple frame of beaten silver, gold, and carved ivory. These precious gates admit to a cool white vault, from which priests and people crowd up a narrow stairway to another small anteroom, and thence through another silver door. This inner sanctum has a silver floor, and silver tables stand before the great jeweled bell of a reliquary which is protected by a glass partition reaching to the ceiling.

This golden dagoba covering the sacred tooth is but the seventh outer covering, each one more richly jeweled than the others and festooned with strings of precious stones. A peacock spreads a tail of rubies and emeralds, and from it hangs the great Kandyan emerald, three inches long and two inches deep. Below that hangs an amethyst two inches long, and the rest of the casket is thick with gems. The innermost cover is almost solidly crusted with rubies.

Besides these in sight, the temple owns great stores of precious stones, and among the elephant caparisons there is one great headpiece for the Tooth's own animal which holds a cat's-eye of heroic size, the largest known.

The breath of many people, the heavily scented air, and the smoke of myriad candles keep the glass partition so dimmed and clouded that one gets slight

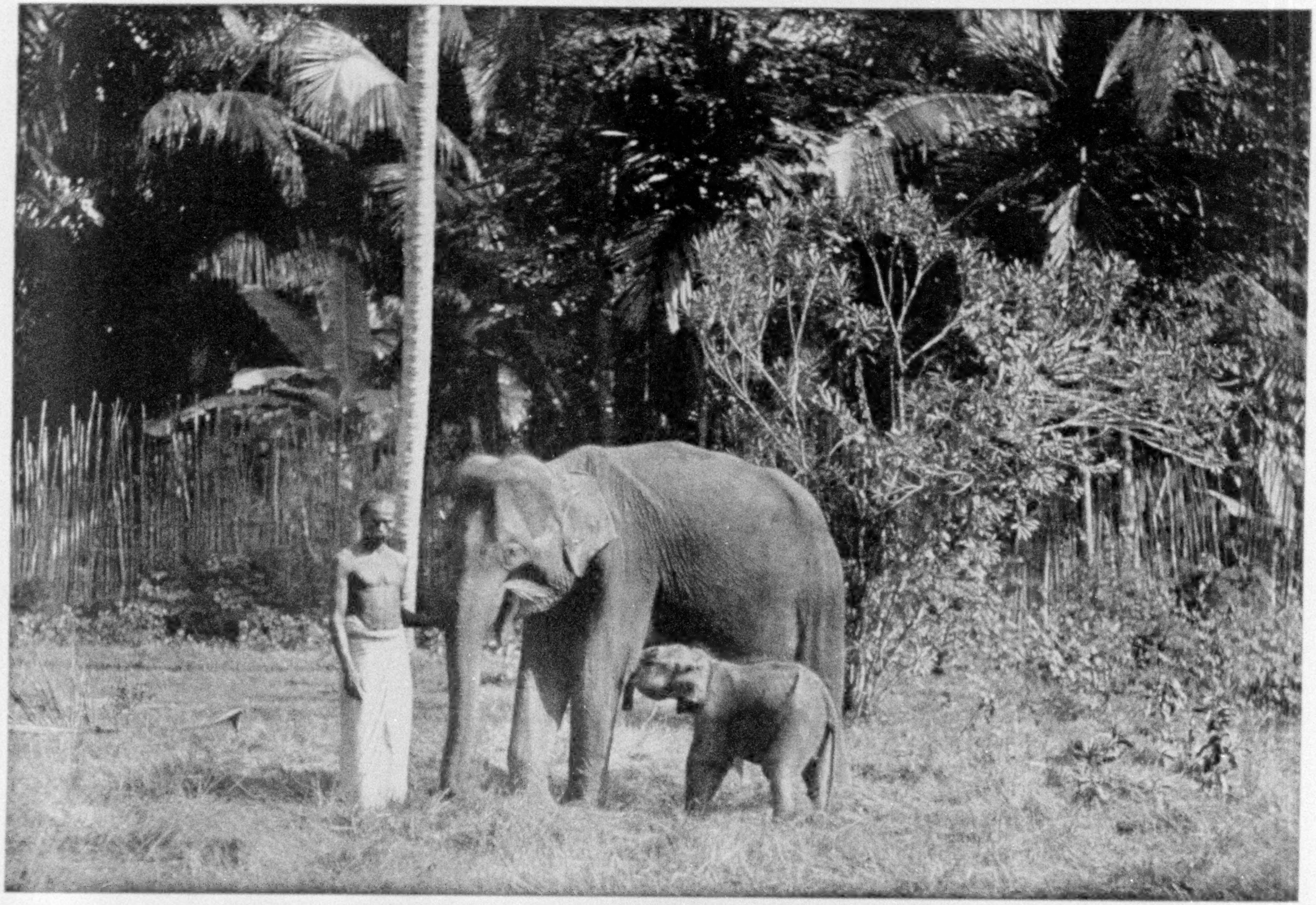
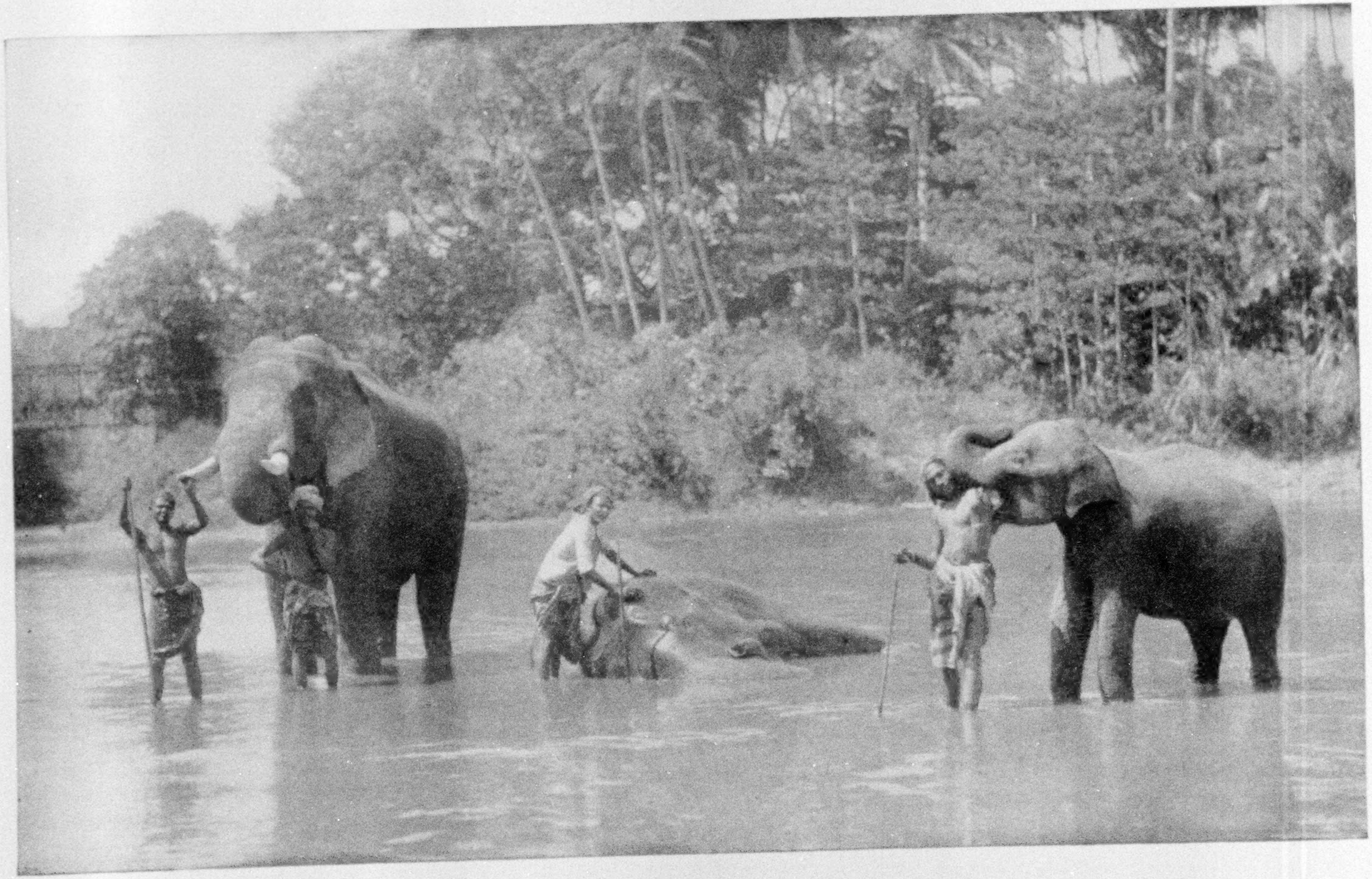


Photo from Dr. Alexander Graham Bell

A BABY ELEPHANT AT LUNCH TIME



ELEPHANTS OF A KANDYAN CHIEF BATHING IN THE MAHAWELI-GANGA, NEAR KANDY

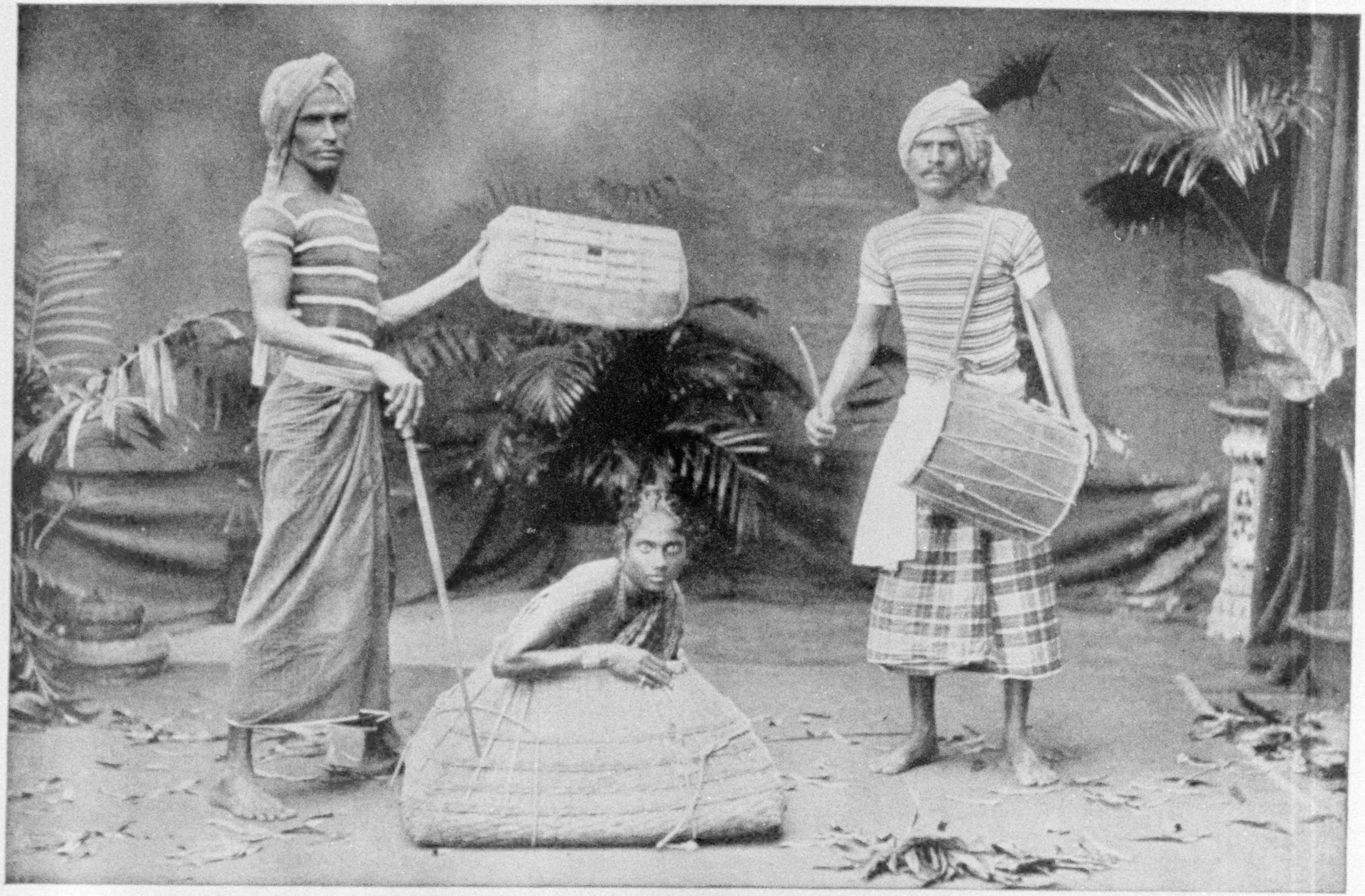
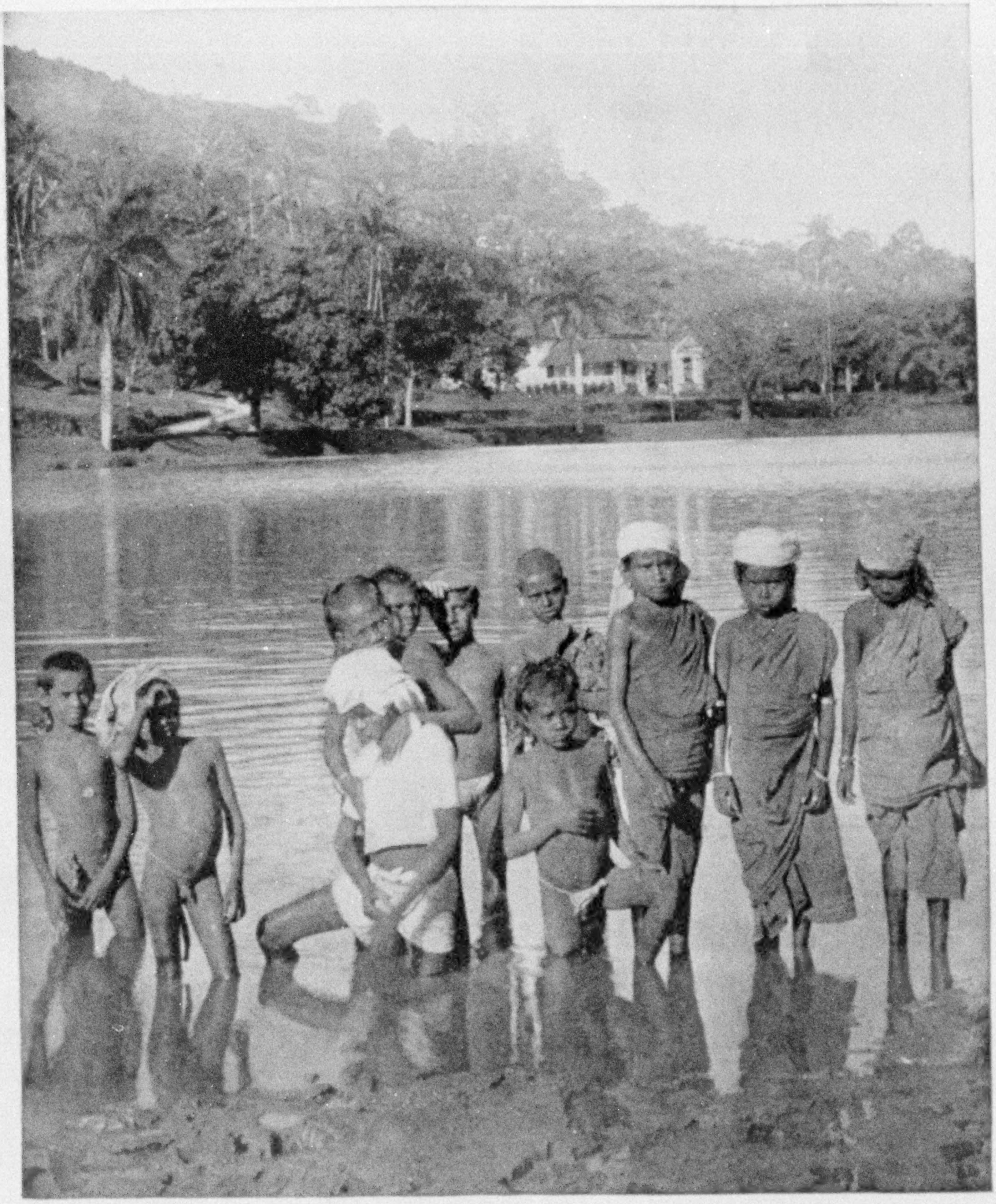


Photo from Dr. Alexander Graham Bell

THE BASKET-TRICK JUGGLER, SHOWING BOY AFTER THE SWORD HAS BEEN RUN REPEATEDLY THROUGH THE BASKET

"A slim boy doubles himself into a basket, ducks his head, and the lid is made fast with ropes and the juggler thrusts sword through and through the basket. The lid is lifted and the boy emerges smiling, while the next juggler plants a mango seed under a bit of cloth, and, when it has grown and pushed the cover high from the ground, one sees the plant with thick rustling leaves still mounting before one's eyes as the grower carefully caresses it" (see page 107).



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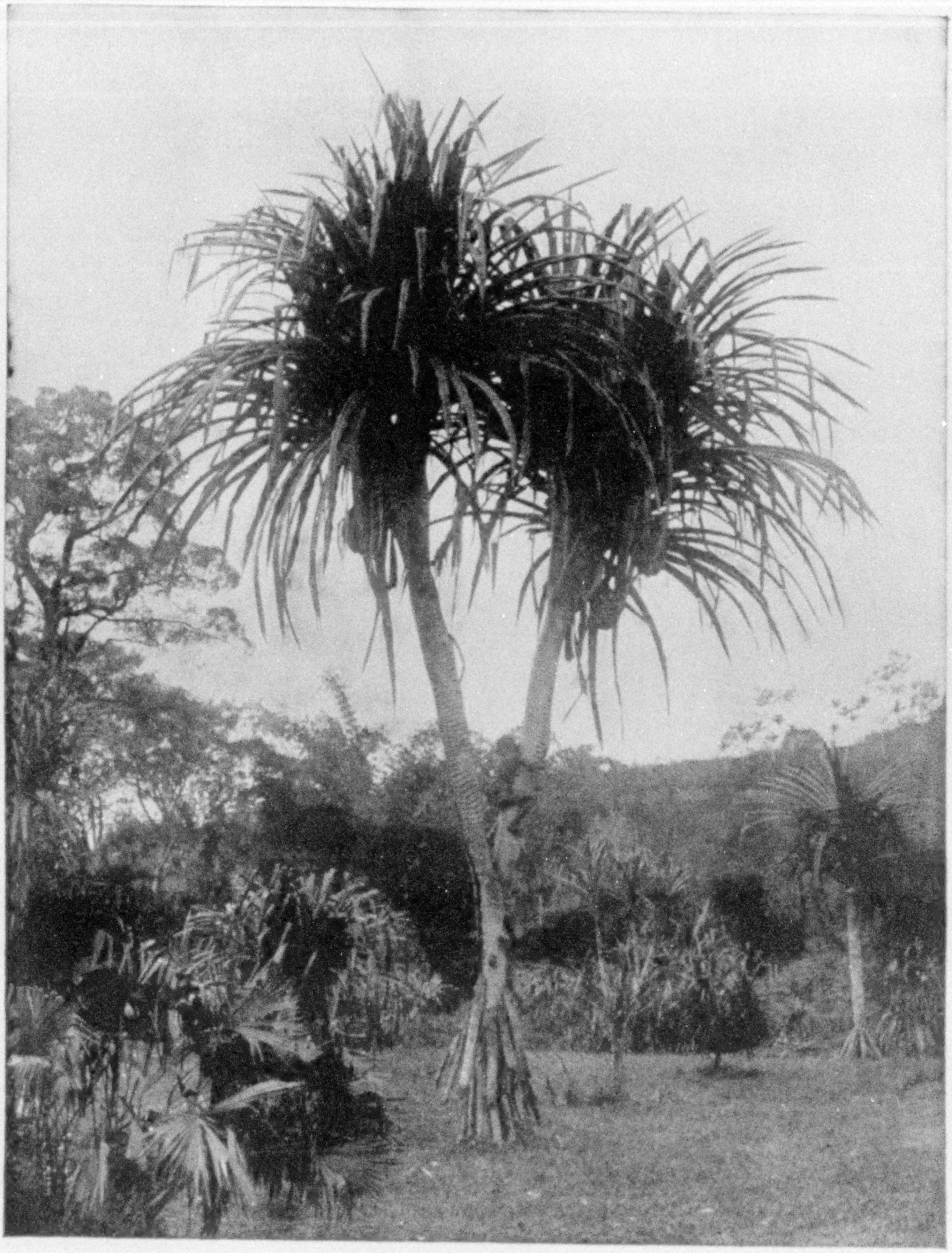
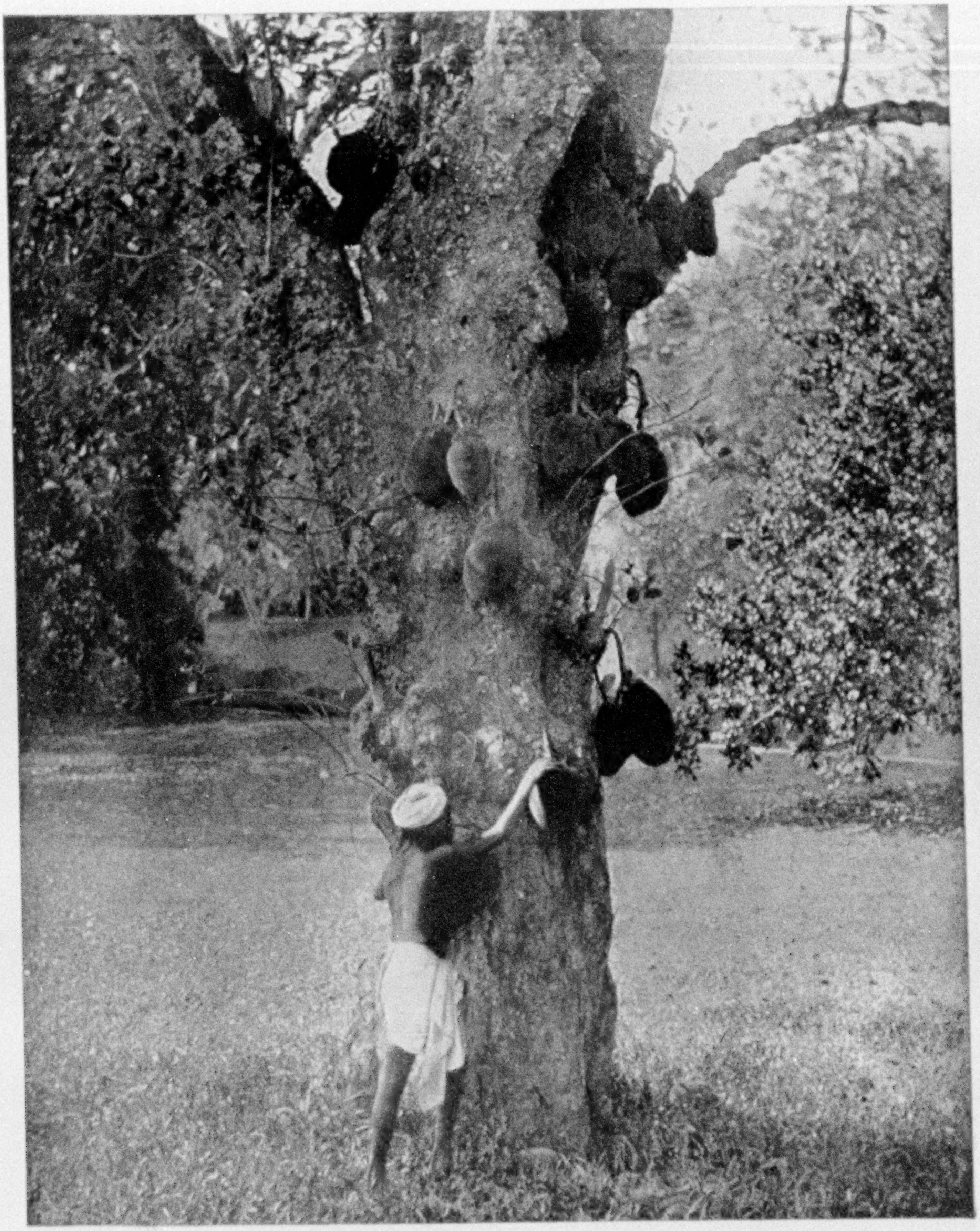
SINHALESE CHILDREN: CEYLON



PANDANUS, OR SCREW PALM: CEYLON

Notice the curious prop roots of the two palms shown in this picture The main stem forms these stout roots which grow obliquely downward to the soil. Often the main stem decays near the ground and the tree is then supported entirely by these prop-like roots.

XUM



THE JACK-FRUIT TREE

The jack tree is a large East Indian tree somewhat similar but inferior to the bread-fruit. The large fruit is from 12 to 18 inches long by 6 to 8 inches in diameter; often weighing 30 pounds or more. The whole fruit is eaten by the natives, the seeds being roasted. Its chief value, however, rests in its wood, which has a grain very similar to that of mahogany, and although at first very light-colored, it gradually assumes the appearance of that wood.

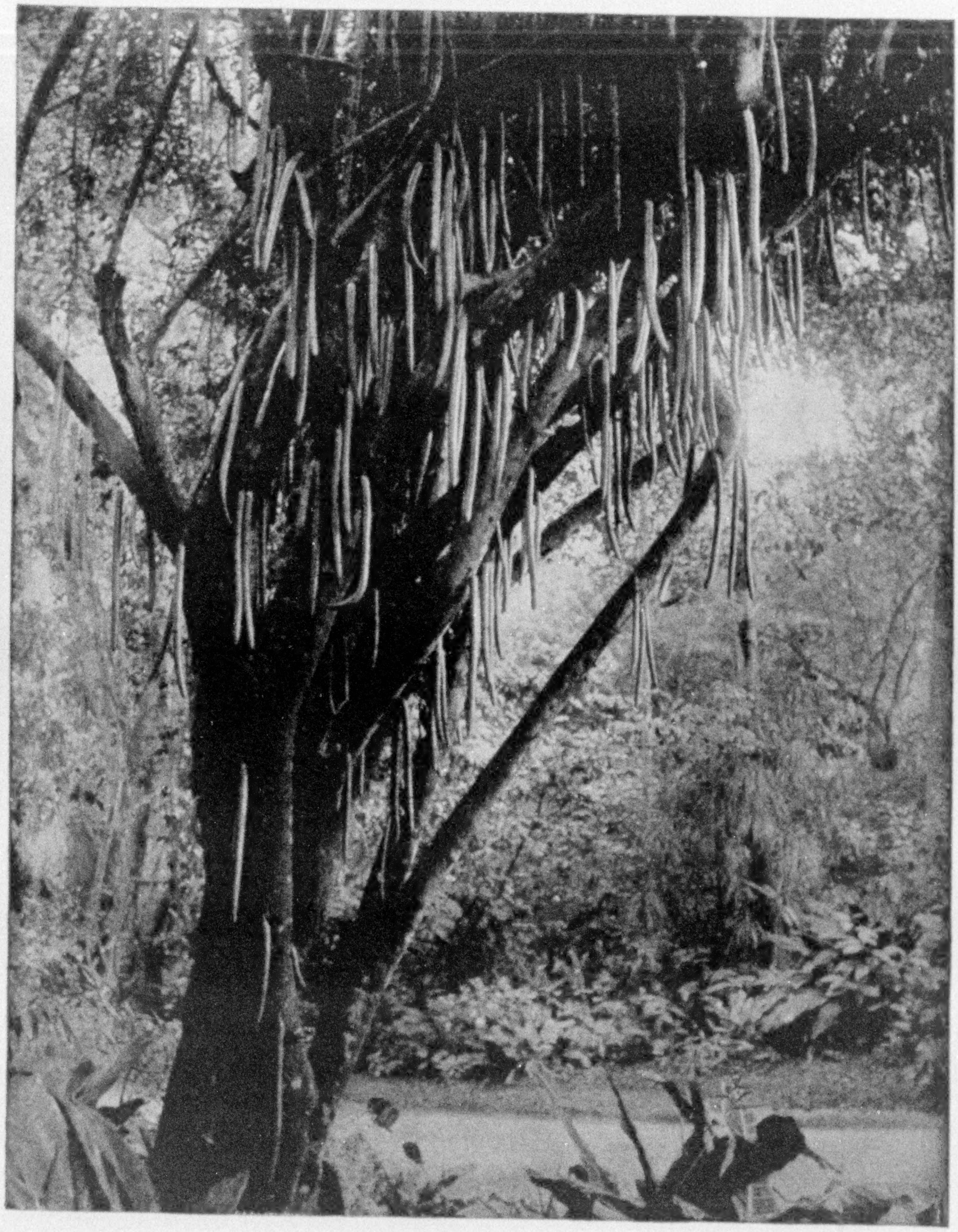


Photo from Eliza R. Scidmore

THE CANDLE TREE, OR PARMENTIERA

Its original name in India is candle tree, for its peculiar fruit resembles candles and contains 60 per cent of very fat oil, used by natives for lamps and also as candles. They have trifoliolate leaves and rather large greenish flowers with a sheathing calyx.

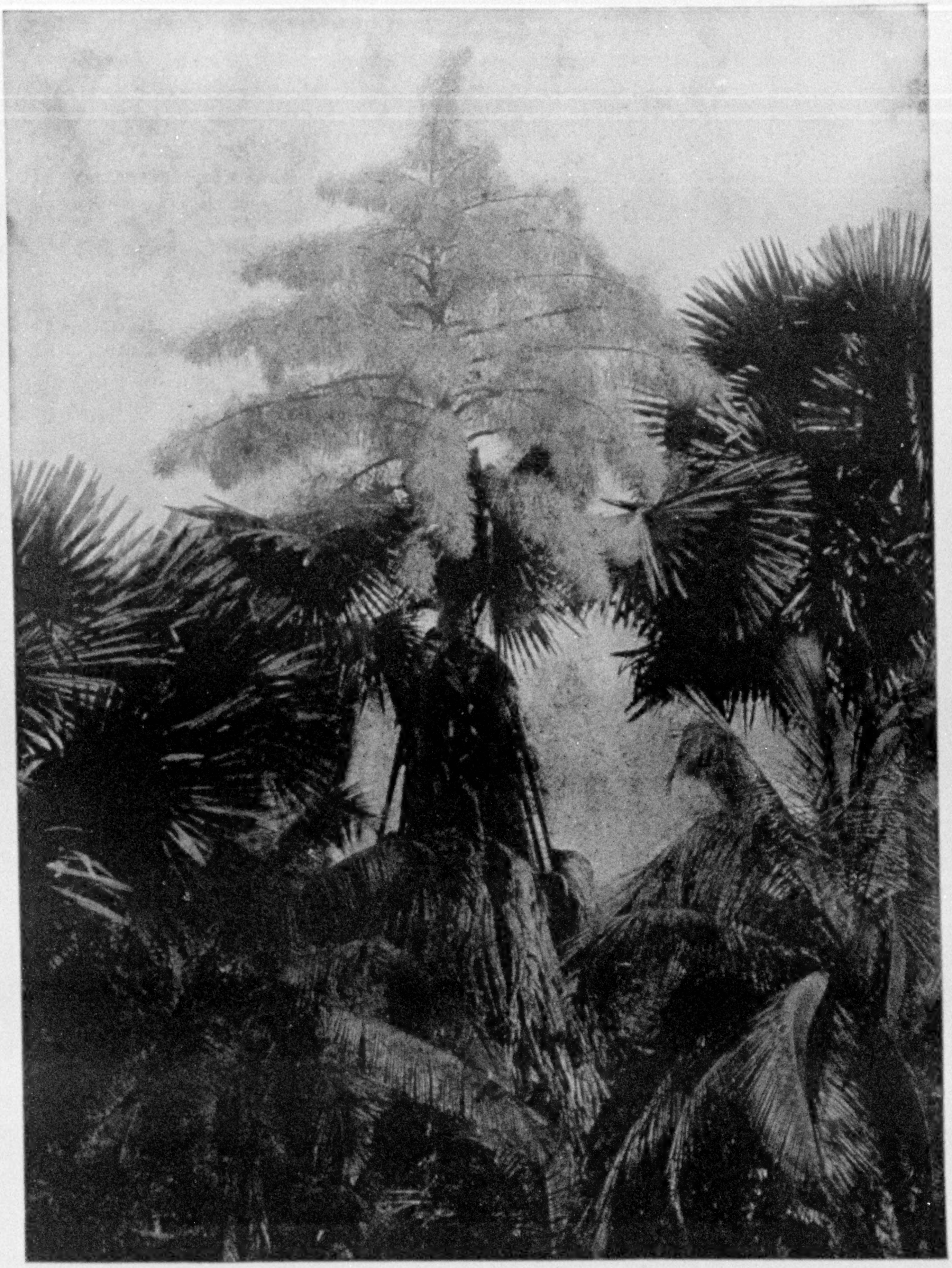


Photo from Eliza R. Scidmore

TALIPOT PALM TREE, ON WHOSE DRIED LEAVES, OR OLAS, THE BUDDHIST SCRIPTURES WERE WRITTEN

It bears this blossom after the age of 40 years—a splendid spike of white flowers 40 feet high. When the flowers fade the tree dies

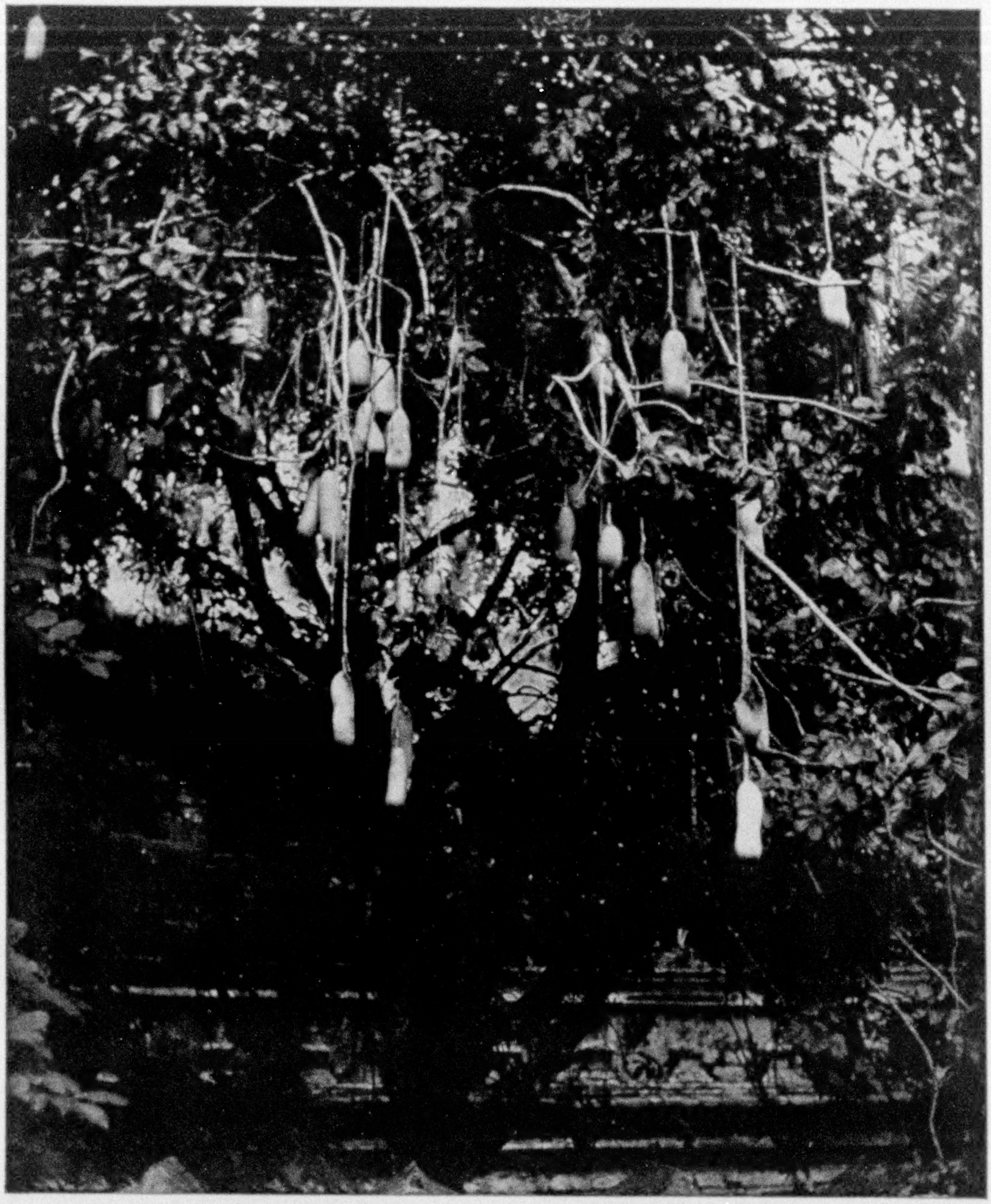


Photo from Eliza R. Scidmore

THE SAUSAGE TREE: CEYLON

This is purely a shade and ornamental tree. It is one of the toughest trees known; the fruit is never eaten

XUM

impression of the surpassing splendor of this jewel show. While the strangers gape at the treasure heap, the guardians, dressed in old Kandyan costumes—bunchy skirts, short jackets, and flaring turbans—have swept away the offerings of the last ceremony, and the worshipers advance ecstatic and kneel to lay their heaps of white flowers on the silver tables until they overflow and the silver floor is piled deep with blossoms and garlands. The grandest guardian of them all extends a gold tray as large as a table top, on which the alien's offering of a silver rupee looks no larger than an anna or a pice.

In the octagonal library overlooking the lake there is a great collection of sacred books, old Pali texts written on strips of palm leaves and bound in covers of carved ivory, ebony, and sandalwood, beaten silver, and gold. There is also a great literature of modern Buddhism by western writers. Buddhist priests from Burma, Siam, and Japan come to study in this library, and all those strange Occidentals who have adopted the Buddhist faith—Colonel Olcott, Madame Blavatsky, Allan McGregor, and Mrs. Besant—have left their names and taken instruction here, although these rather intelligent and scholarly Kandyan priests smile and shake their heads at the mention of mahatmas, yogis, and all the hocus-pocus of the theosophist offshoots of the northern school.

There is preaching in the temple and chanting of the sacred books on each night of the full moon. On the full-moon nights of June, July, and August—the anniversaries of the chief events in the life of Gautama Buddha, the Great Renunciation, the Great Enlightenment, and the entry into Nirvana—there are greater services, the August festival lasting for a fortnight, with elephant processions every night.

I went one full-moon night to the services in a new temple deep in a dell off Lady McCarthy's Road, at the far end of Kandy. The people were coming and going all night long, and there were stalls for the sale of fruits, rice, and drinks at the gate. Children ran about and played in the temple courts or slept on their mothers' knees.

A circle of priests sat in an inner sanctuary and between dark and dawn chanted the whole text of the Tripitakas, or "Three Baskets" (of wisdom), relays of yellow-robed celebrants succeeding one another every two hours. They chanted in deep, resounding voices, as steady and continuous as the roar of the surf, without break, quaver, or pause, sitting motionless for each two hours' turn. In this same way Buddhist priests have repeated the sacred texts every full-moon night for 25 centuries, the oral version passed on and kept pure in this way.

The drives and walks around Kandy are enough to occupy one for weeks. One drives to far temples on picturesque hills and pinnacle rocks, to tea estates, to the Botanical Garden, and to the river bank every afternoon to watch the temple elephants enjoy their bath and a water carnival. New roads are always being made, and Lady McCarthy's Road, Lady Gordon's Road, Lady Longden's Drive, and Lady Blake's Drive are named for as many chatelaines of Government House, who interested themselves in developing the beauties of Kandy. Lady Horton's Walk is more fascinating than them all, and strikes straight up the forested hillside back of the King's Pavilion into an enchanted jungle, winding far around on the hills, with views out and down on the lake and the town.

The Peradeniya Gardens, four miles away, present every beautiful and useful tree, plant, and flower that will grow in this ideal climate of eternal June. One walks in wonderland down one avenue of giant rubber trees, along another of royal palms, past groups of talipot, palmyra, and soaring areca palms, gigantic fans of travelers' palms, clumps of giant bamboo soaring a hundred feet in air, groves of nutmeg and cinnamon trees, ponds of victoria regia, thickets of tree ferns, mats of blue iridescent ferns, and long borders of sensitive plants.

The orchid-house delights one, with all its hundreds of baskets and pieces of mossy branches hanging in the open air, only mat awnings sheltering the treas-

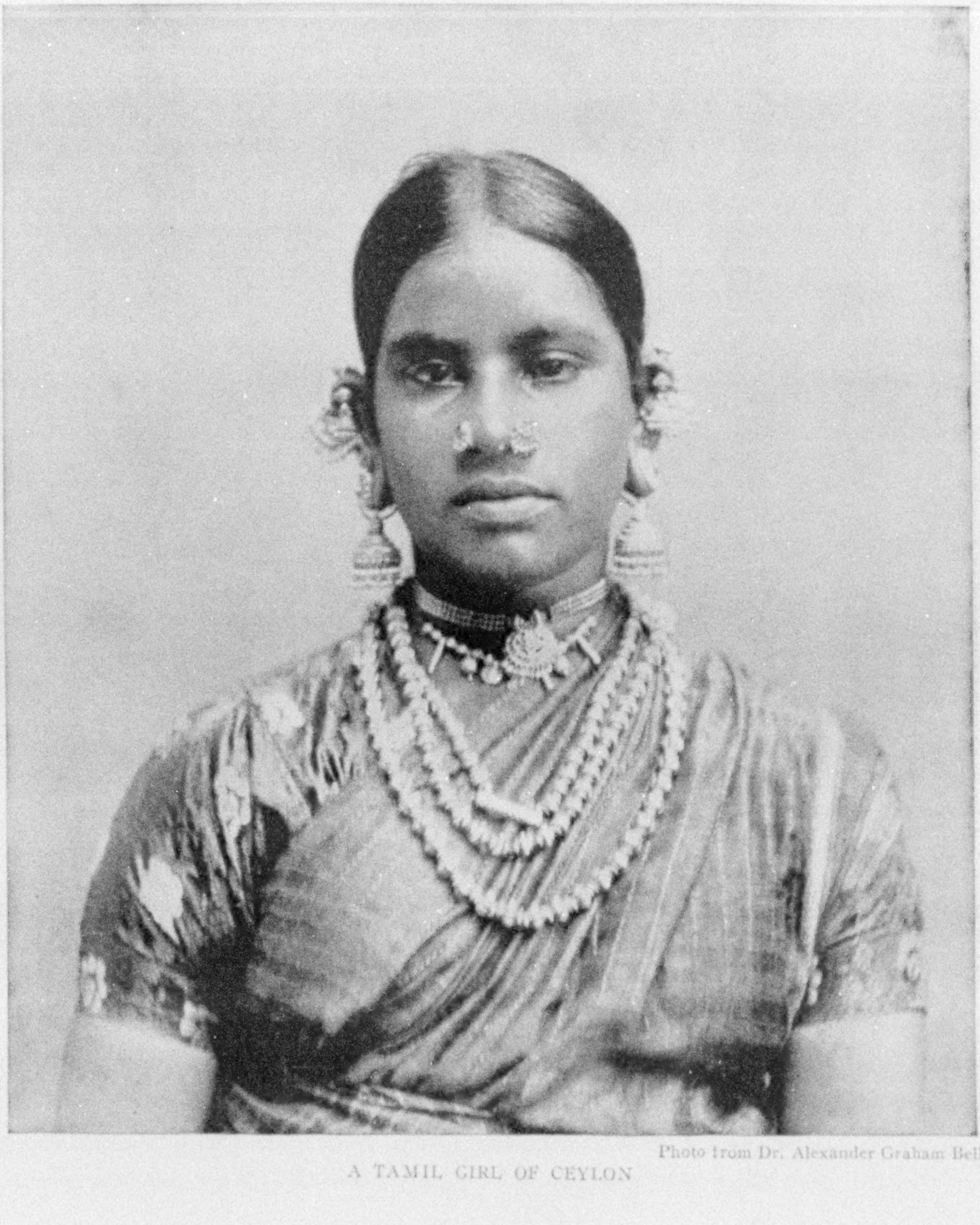


Photo from Dr. Alexander Graham Bell

A TAMIL GIRL OF CEYLON

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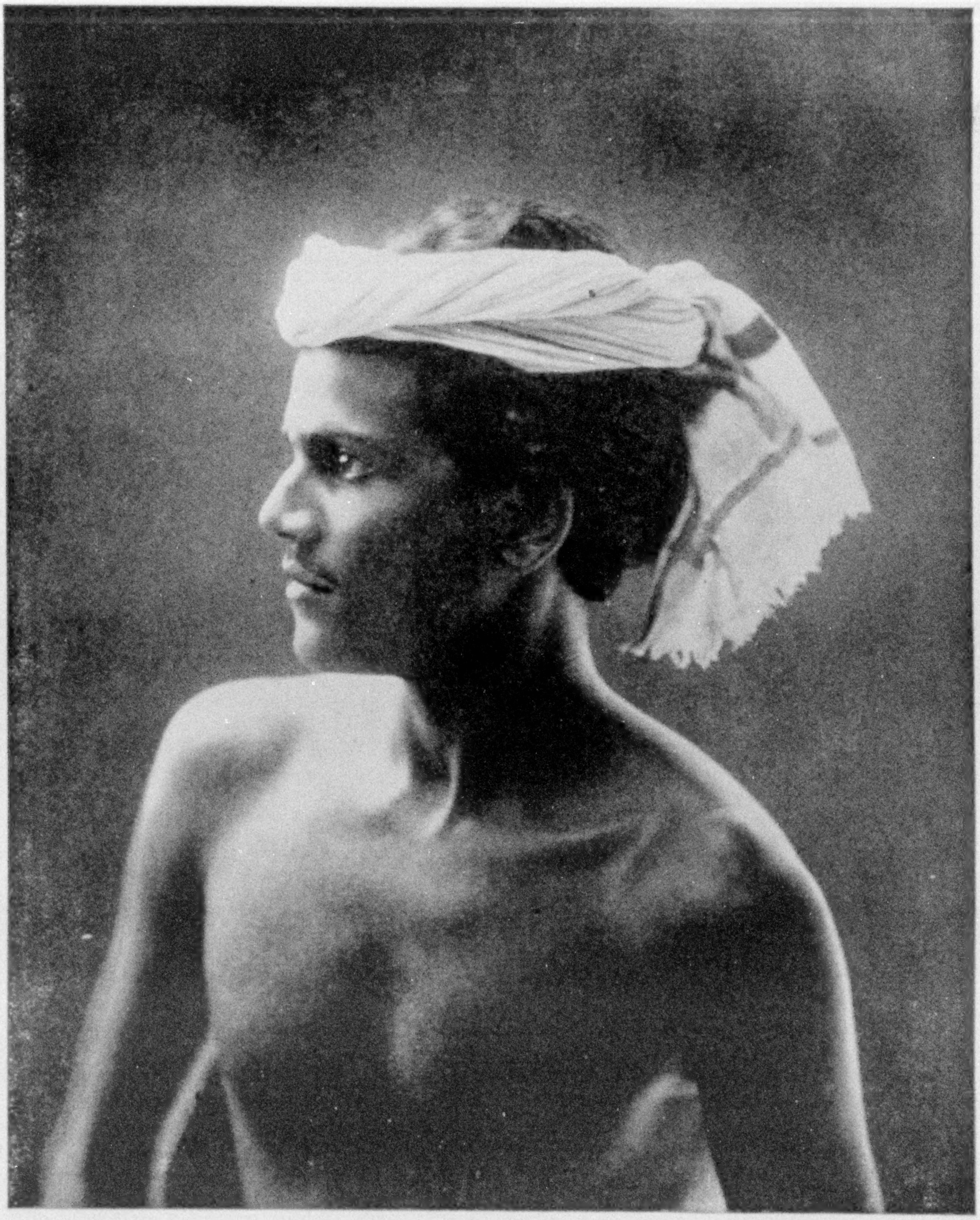

Photo from Dr. Alexander Graham Bell

A YOUNG TAMIL OF CEYLON

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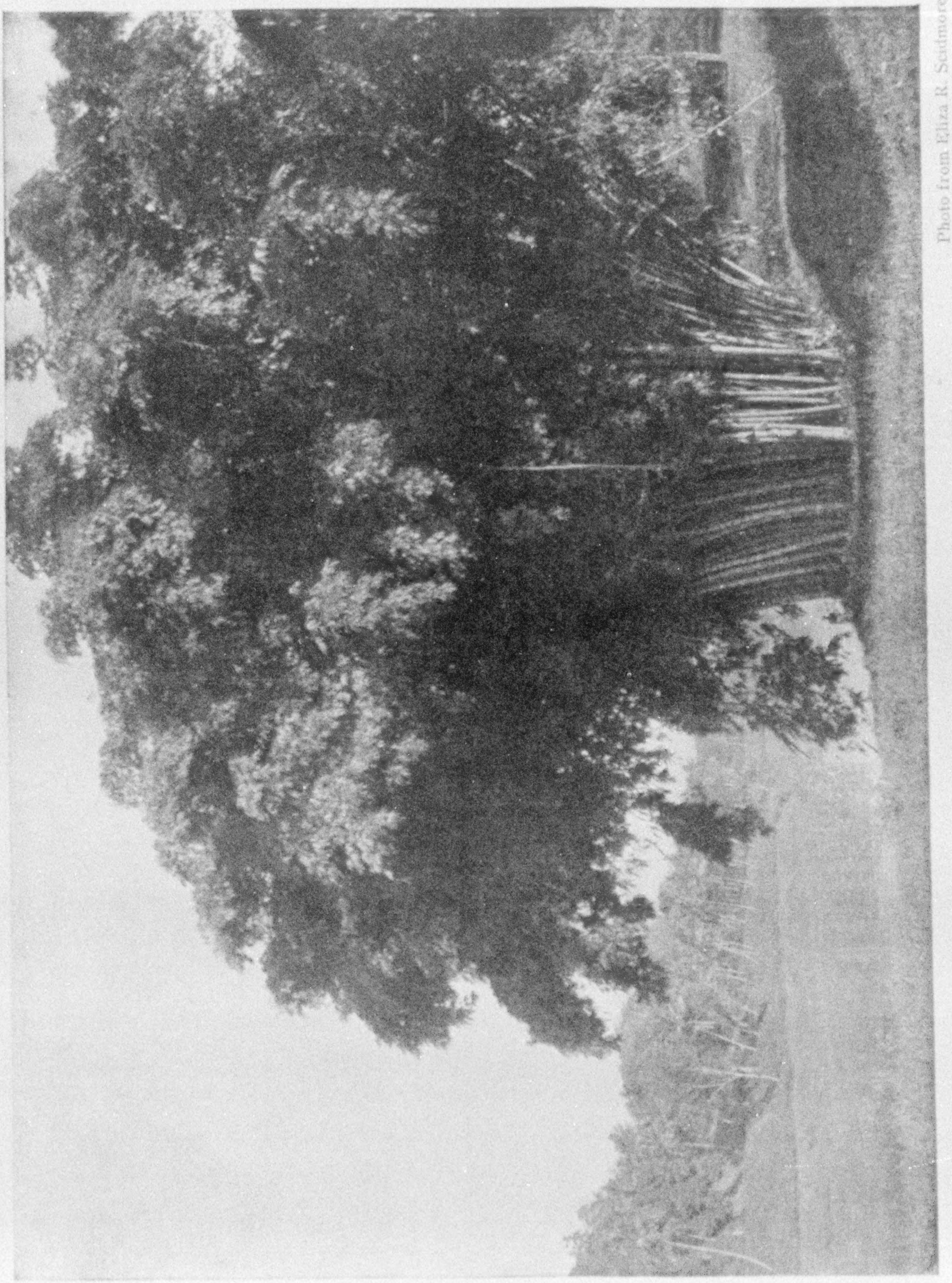
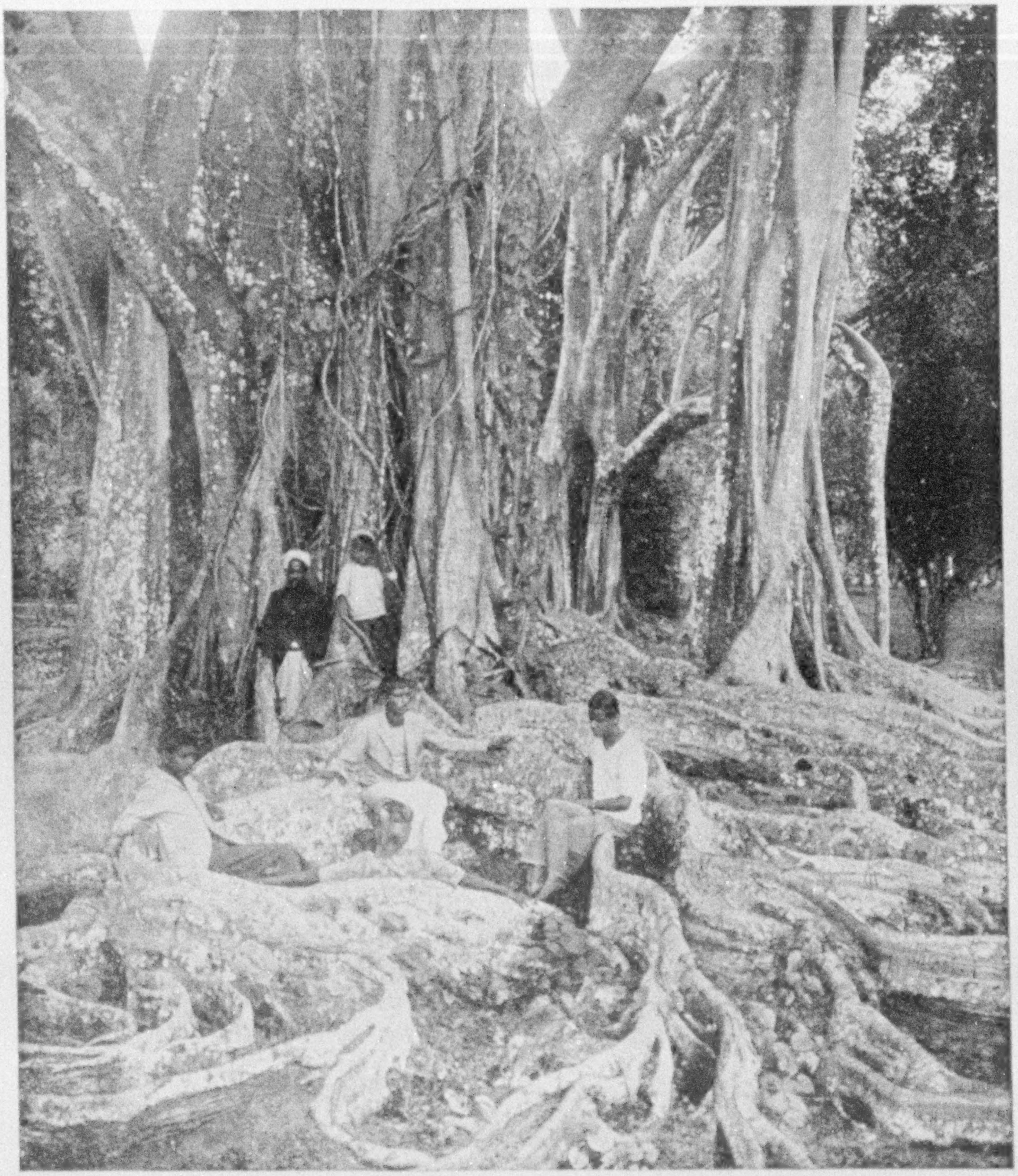


Photo from Eliza R. Scidmore

CLUMP OF GIANT BAMBOO (OVER 100 FEET HIGH) BY THE RIVER BANK IN PERADENIYA GARDENS

These Malacca bamboos are 9 inches in diameter and sometimes grow a foot a day during the midsummer rains. The immense size of this clump is indicated by the small human figure



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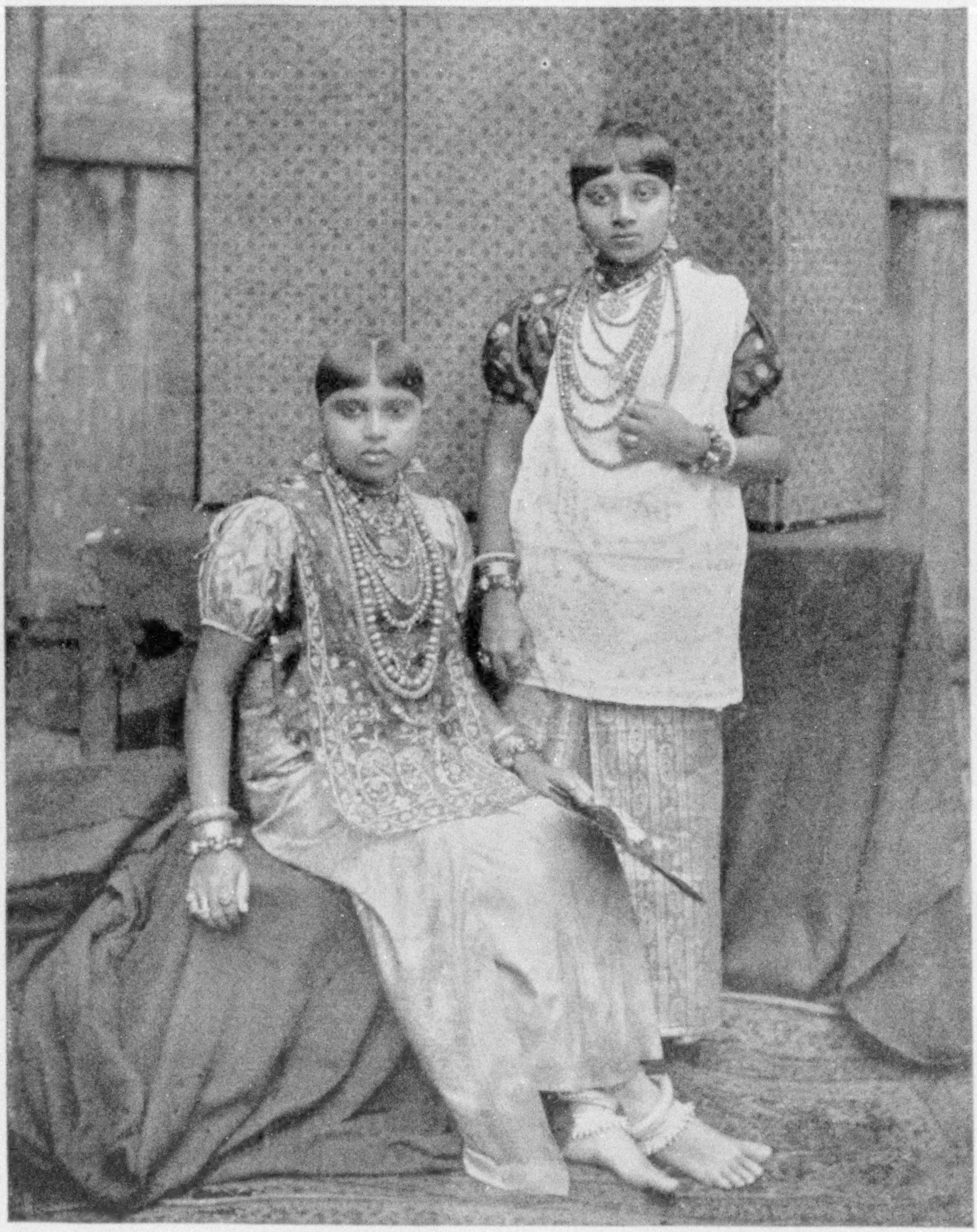
ASSAM RUBBER TREE: PERADENIYA GARDENS, KANDY (SEE PAGE 127)

"The Peradeniya Gardens, four miles away, present every beautiful and useful tree, plant, and flower that will grow in this ideal climate of eternal June. One walks in wonderland down one avenue of giant rubber trees, along another of royal palms, past groups of talipot, palmyra, and soaring areca palms, gigantic fans of travelers' palms, clumps of giant bamboo soaring a hundred feet in air, groves of nutmeg and cinnamon trees, ponds of victoria regia, thickets of tree ferns, mats of blue iridescent ferns, and long borders of sensitive plants."



DAUGHTERS OF A KANDYAN CHIEF

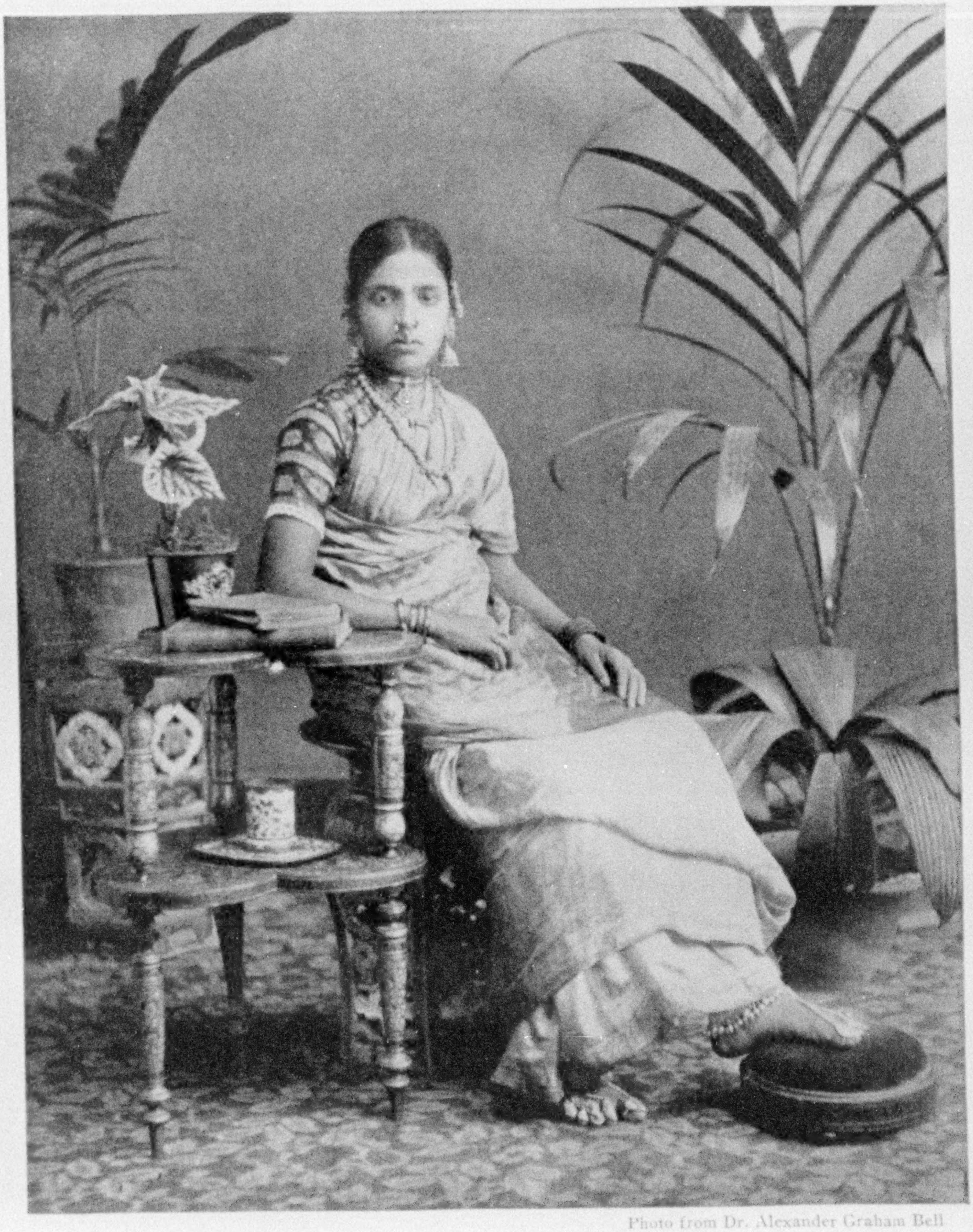
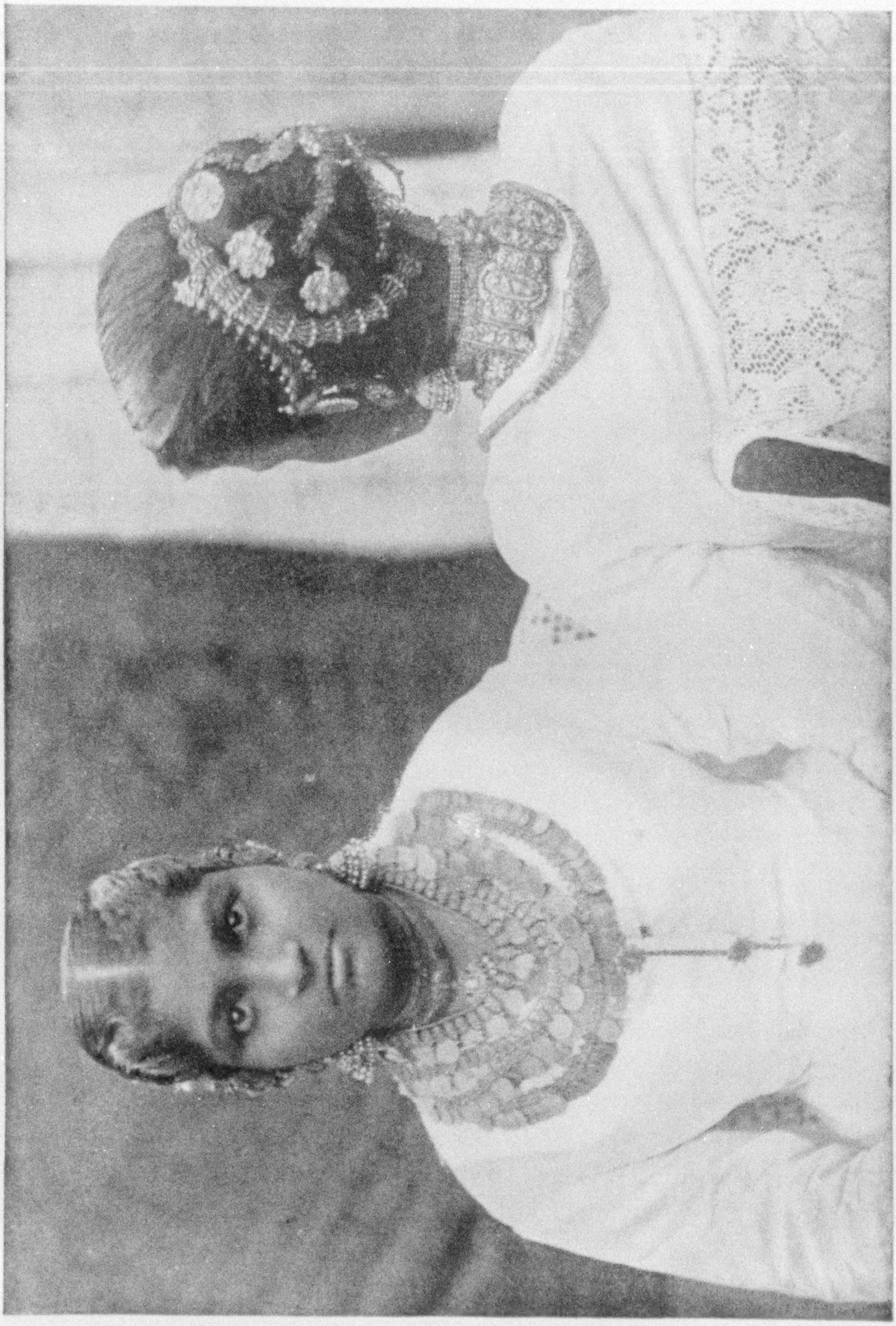


Photo from Dr. Alexander Graham Bell

A TAMIL WOMAN OF CEYLON: NOTE THE RINGS ON HER TOES



TAMIL WOMEN AT JAFFNA; NECKLACES OF COINS AND BEATEN GOLD ured ones that hide in the farthest and darkest jungles.

A bare tree hanging full of strange black fruits proves to be only the sleeping place of a colony of "flying foxes," or huge bats, that fly by night and at sunrise grip a tree branch by one foot, fold their 24-inch-long wings, and, hanging head down, sleep the whole day away.

THE FOOTPRINTS OF BUDDHA

The railway carries one up to Hatton, 4,141 feet above the sea, in the next 30 miles, into the heart of the oldest tea district, that was a great coffee district before the blight of 1870 ruined that greatest industry of the island. There is a splendid view of Adams Peak from Hatton, and one may drive across the hills all striped with round tea bushes, shaded by grevillea, or rubber trees, and following the banks of the beautiful Maskeliya reach the foot of the peak. Then comes a few miles on pony or chair, and after that serious climbing the last part a stiff pull up over sheer rock faces by the aid of heavy iron chains that have been there for ages. There is barely room for the tiny temple over the sacred footprint of the Buddha, 7,353 feet above the sea.

Believers of three creeds have made the pilgrimage and met there for centuries without any discord or such unseemly behavior as when two sects of Christians meet in Jerusalem. All aim to reach the summit at sunrise, when the great shadow of the peak is thrown upon the sky as at the Brocken and the view ranges far over Ceylon and to the ocean.

The Buddhists believe that Gautama Buddha, who came to Ceylon in a storm cloud, landed on this peak, and they celebrate that event every April, with the elaborate footprint in the solid rock the sufficient proof. The Hindus, or Tamils, believe that Siva stood there on the summit when he stirred the sea with his trident. The Mohammedans believe that Adam once stood there, and the Catholics have tradition of St. Thomas having visited the peak.

From Hatton the railway climbs another thousand feet in a run of 20 miles through a continuous tea district, all the hills cleared and planted in orderly rows of bushes, guarded by their attendant, thin-foliaged shade trees, and 50,000 acres of tea bushes are always in sight from the train. Tea will thrive everywhere from sea-level to 7,000 feet, but the best plantations are between 2,500 and 4,500 feet above the sea.

All land above 5,000 feet is now reserved as crown forest land, and ebony and many valuable woods are being replanted after the centuries of spoliation.

At Nanu Oya station one changes to a primitive, bone-breaking train of tram cars, the toy cars, and the absurd little vehicles jolt and rumble and threaten to buckle in air whenever the brakes are applied. The busy little engine pants up another thousand feet in the four miles and lands one at the great upland resort of Nuwara Eliya, "Nurelya"—as our English cousins shorten it in pronunciation.

This most ideal summer resort, 6,210 feet above the sea, offers one grate fires every evening and morning and blankets every night, and meanwhile flowers bloom with California profusion in the many beautiful bungalows that surround the wide ellipse of a level valley, where club-houses, a race-course, and golf links minister to a Briton's necessities. The Governor has a summer home; there are hospitals and sanatoriums.

At the mouth of the valley lies the Hakgalla Botanical Garden, where one sees the most wonderful tree and all other ferns in this chosen region of tree ferns. The huge fronds show on every hillside and in every gully, and they used to be the favorite food of the herds of wild elephants that roamed here and nipped out the juicy but at the heart of the fern.

The gardens command a magnificent view, and over a great amphitheater of tea-clad hills and valleys and straight across on the opposite hills show the galvanized-iron sheds, where some 1,800 hale and hearty, strapping, big Boer prisoners were fed and fattened in idleness for more than a year after their surrender in South Africa. The slow Sinhalese brain could not understand that absurdity, for in their wars they either knocked their prisoners on the head,

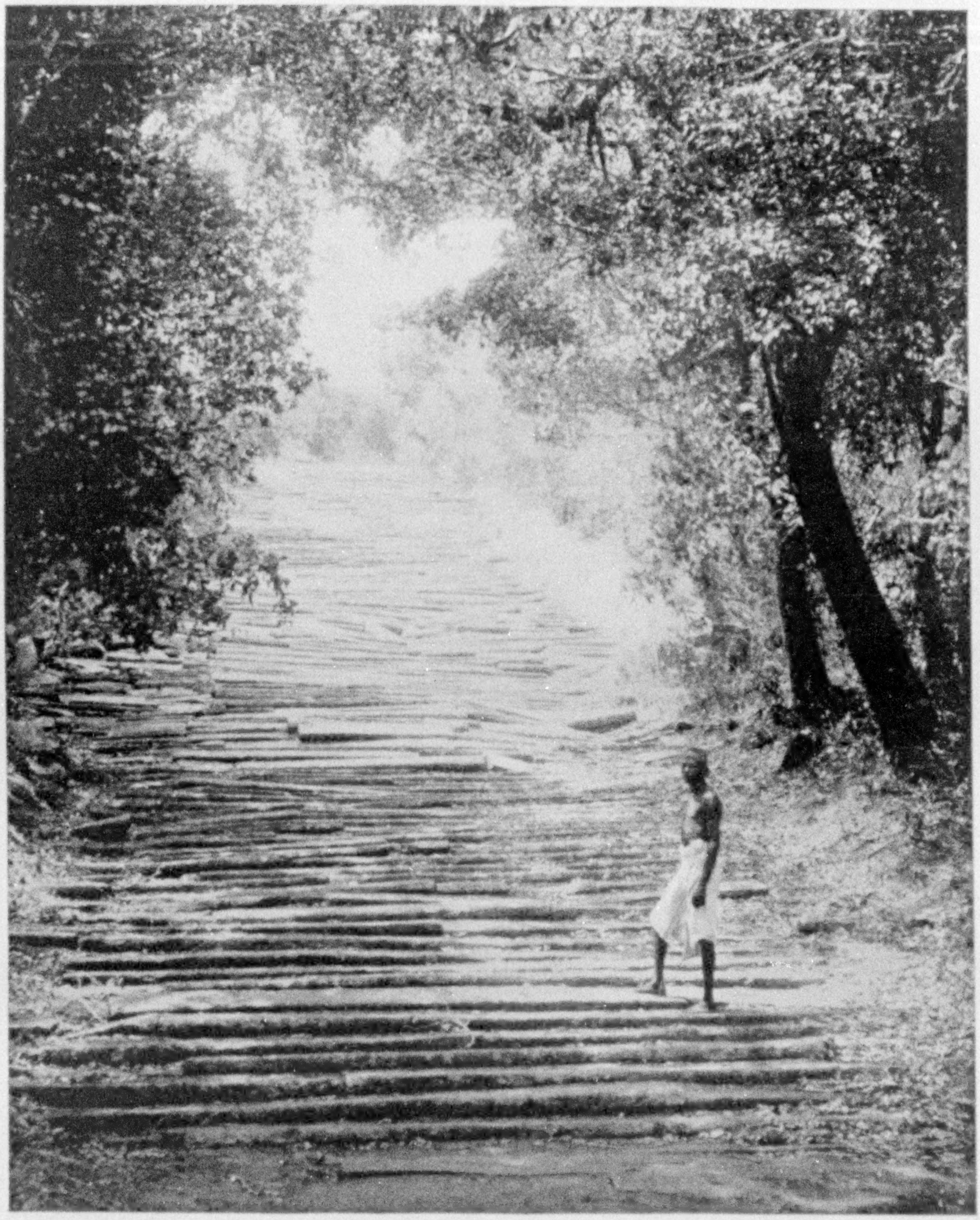
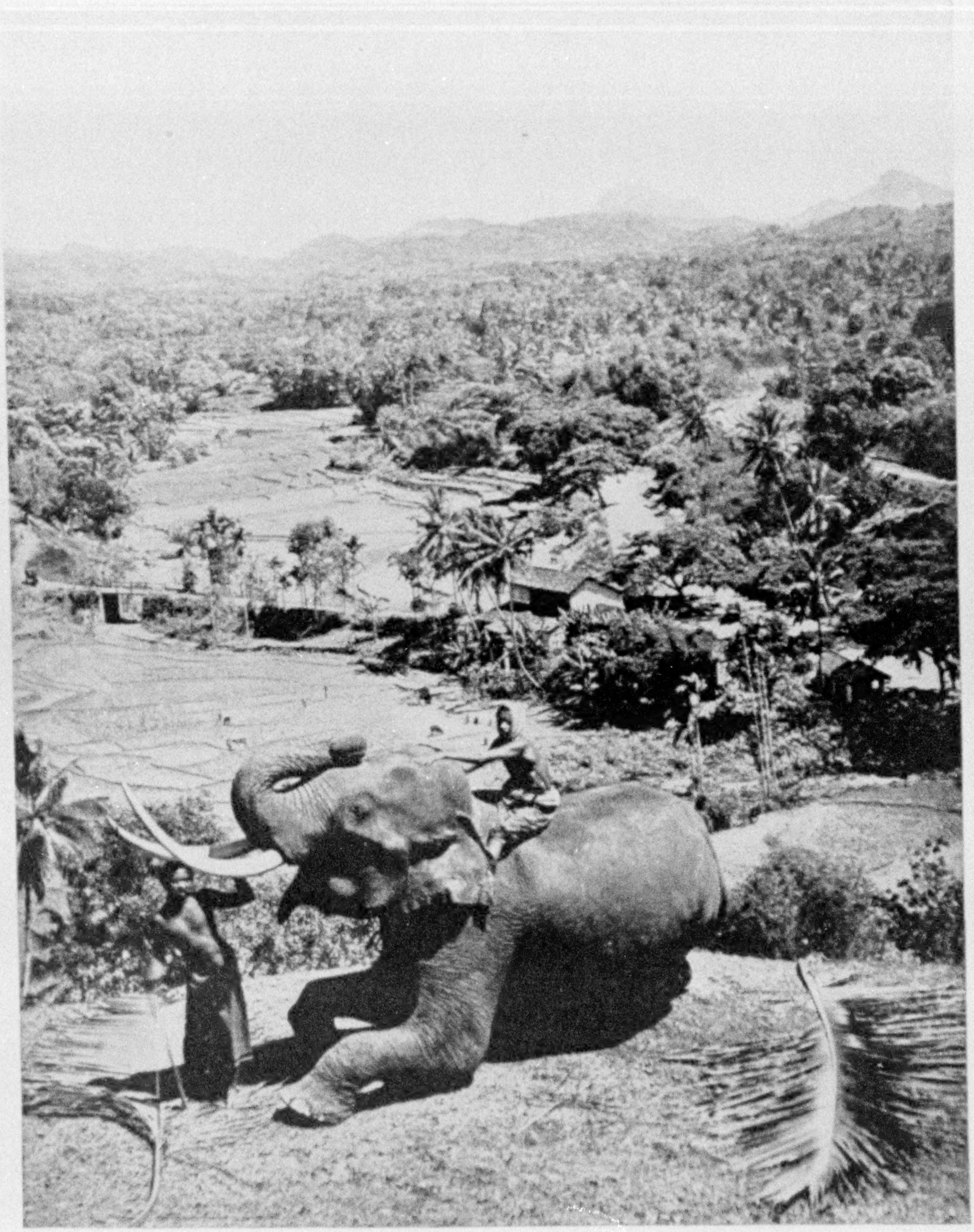


Photo from Dr. Alexander Graham Bell

STAIRCASE OF 1,840 GRANITE SLABS LEADING TO THE TOP OF MIHINTALE, THE SACRED MOUNTAIN

This is where Prince Mahinda, son of the Emperor Asoka, arrived in 307 B. C. to preach Buddhism. Mahinda lived there to the end of his life, and the whole mountain is covered with ruins of sacred edifices (see page 145).



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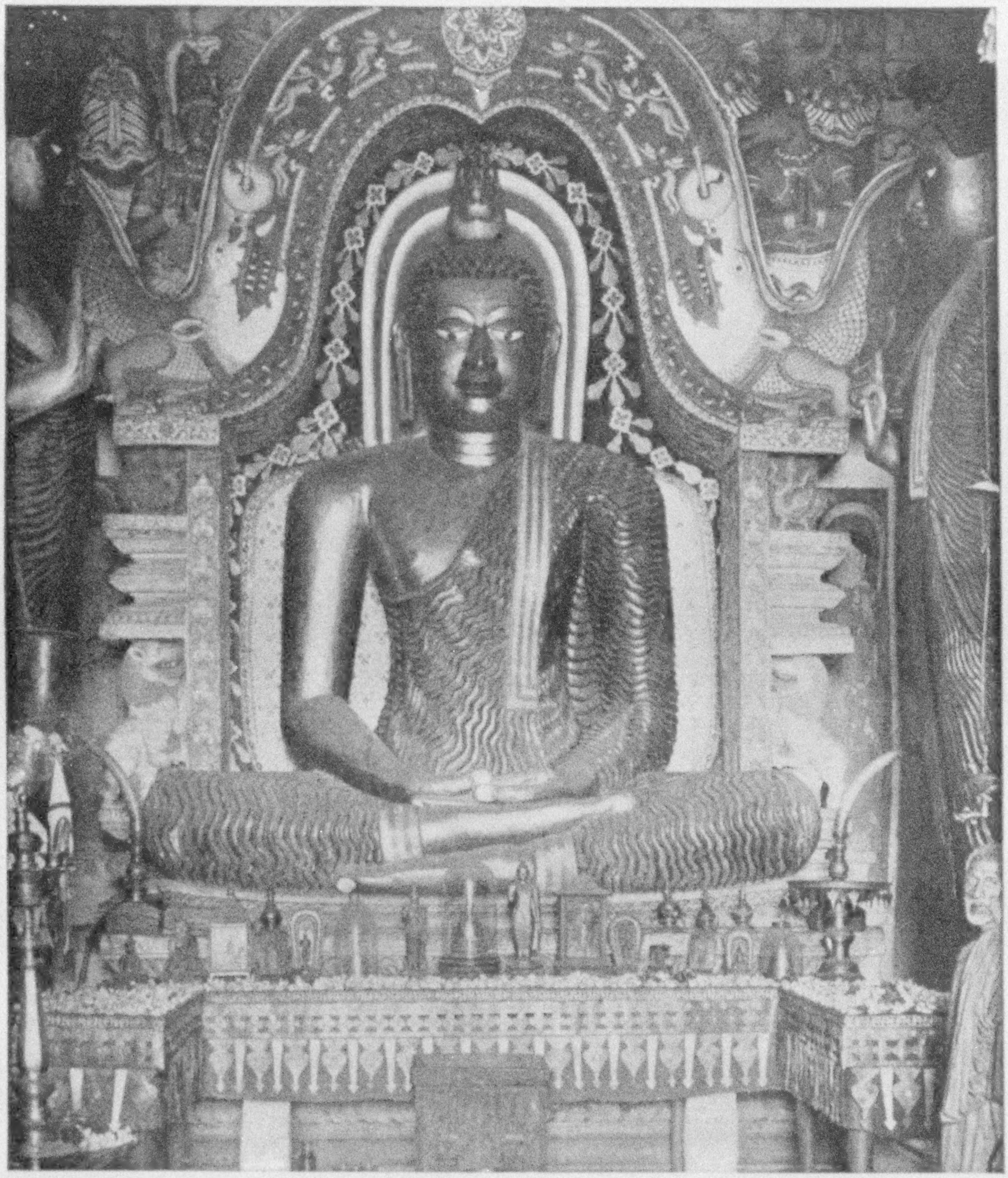
VIEW OF THE KANDYAN COUNTRY, LOOKING TOWARD THE MATALE HILLS: NOTE THE RICE TERRACES AND MEN AT WORK IN THEM

XUM



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THE SITTING BUDDHA AND ELABORATELY DECORATED SHRINE: LANKATILAKA TEMPLE, 11 MILES FROM KANDY, A MOST PICTURESQUELY PLACED SHRINE ON THE TOP OF AN ISOLATED ROCK

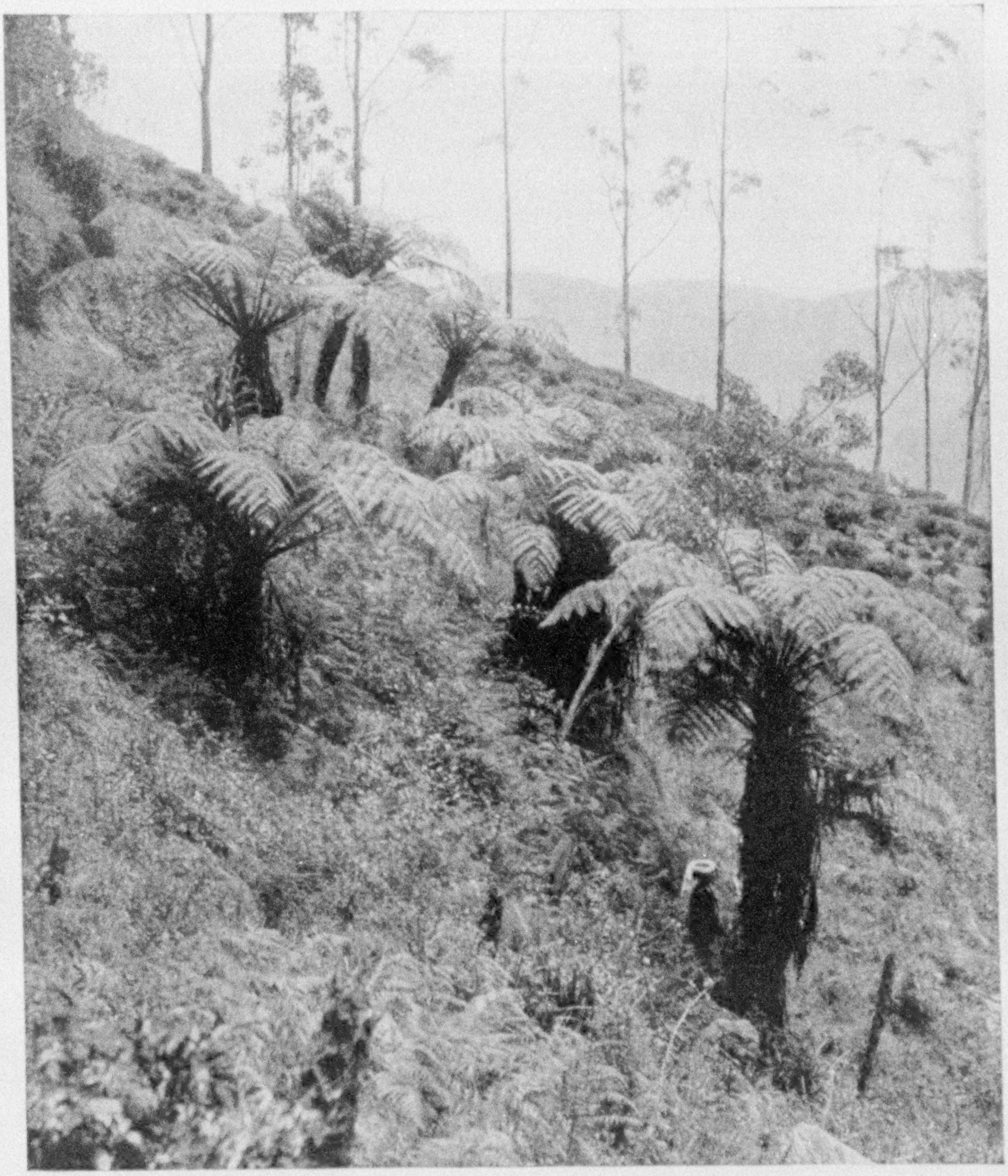

Photo from Dr. Alexander Graham Bell

TREE FERNS

"At the mouth of the valley lies the Hakgalla Botanical Garden, where one sees the most wonderful tree and all other ferns in this chosen region of tree ferns. The huge fronds show on every hillside and in every gully, and they used to be the favorite food of the herds of wild elephants that roamed here and nipped out the juicy but at the heart of the fern."

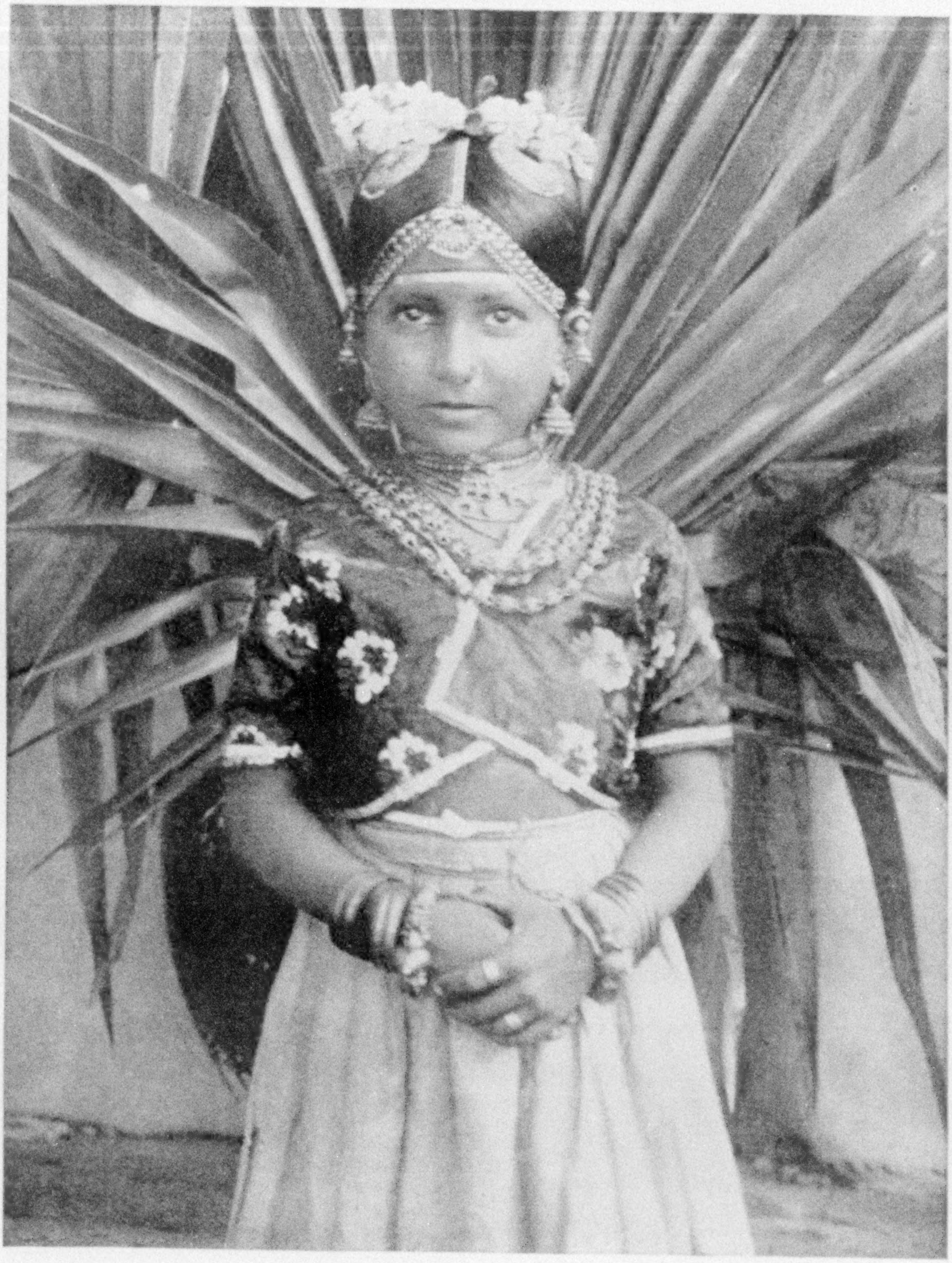

Photo from Dr. Alexander Graham Bell

TAMIL GIRL: EASTERN PROVINCE OF CEYLON

Photo from Dr. Alexander Graham Bell

A SINHALESE GIRL OF CEYLON

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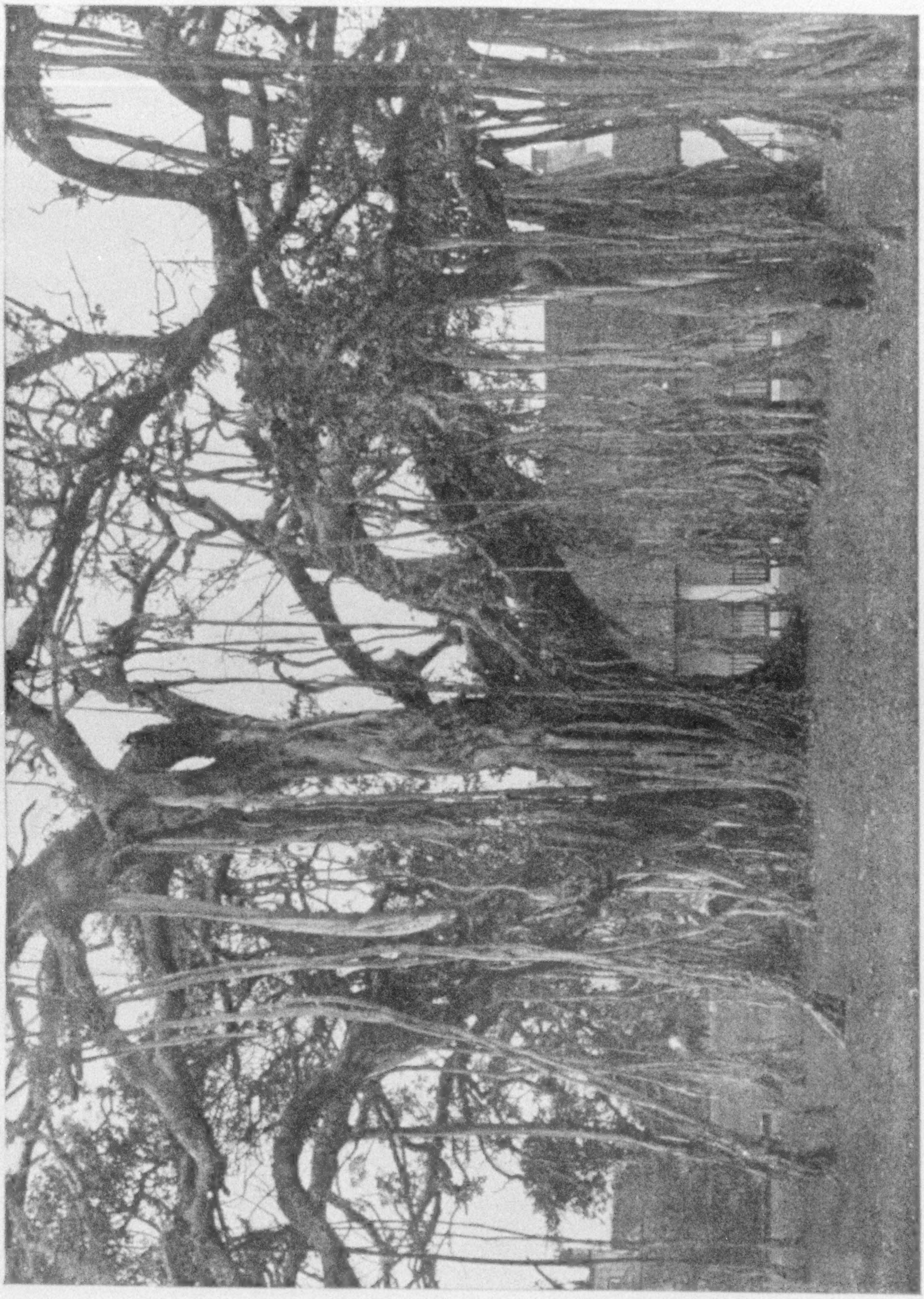


THE BANYAN TREE (*Ficus indica*) IN THE GARDENS OF COLOMBO (SEE PAGE 107)

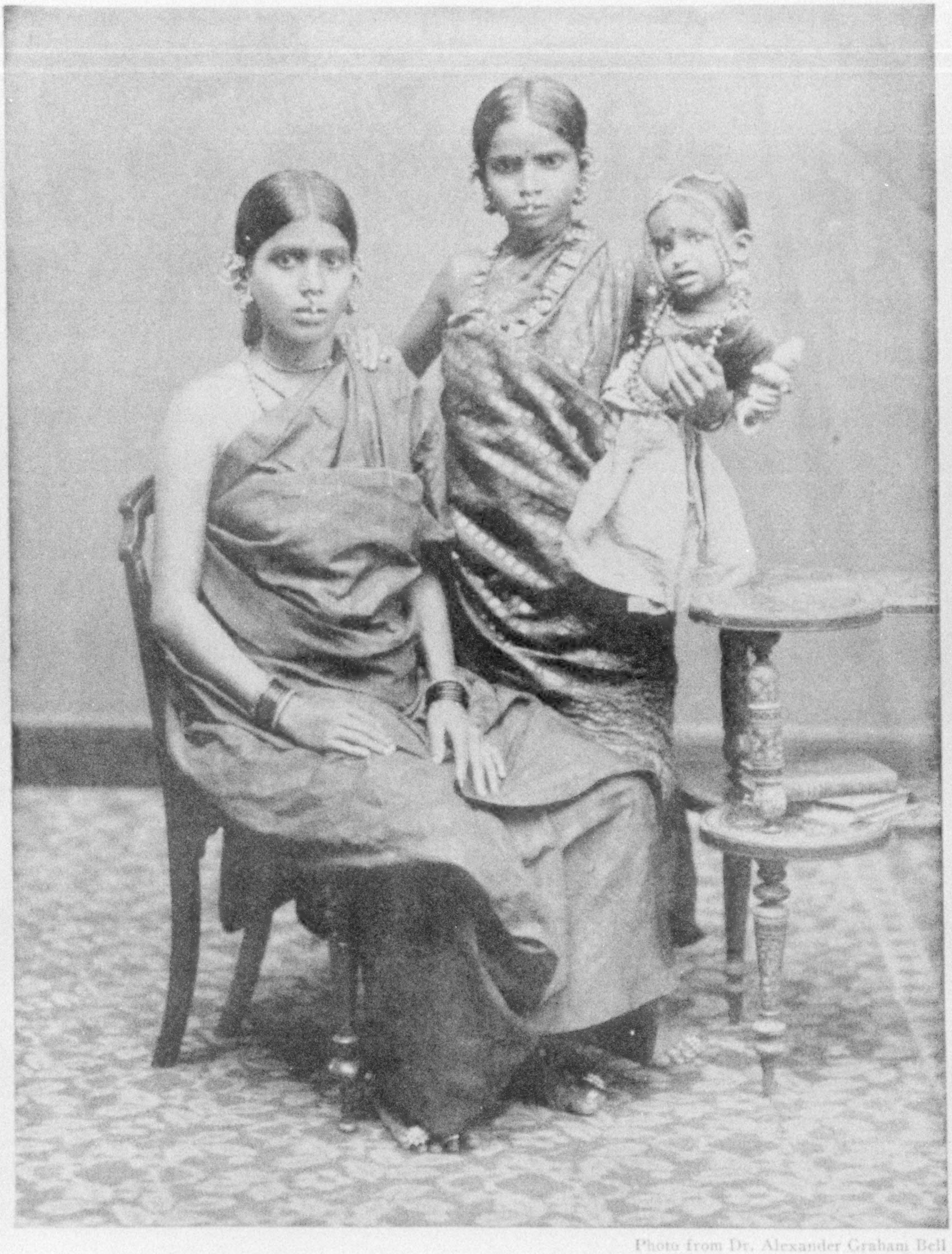
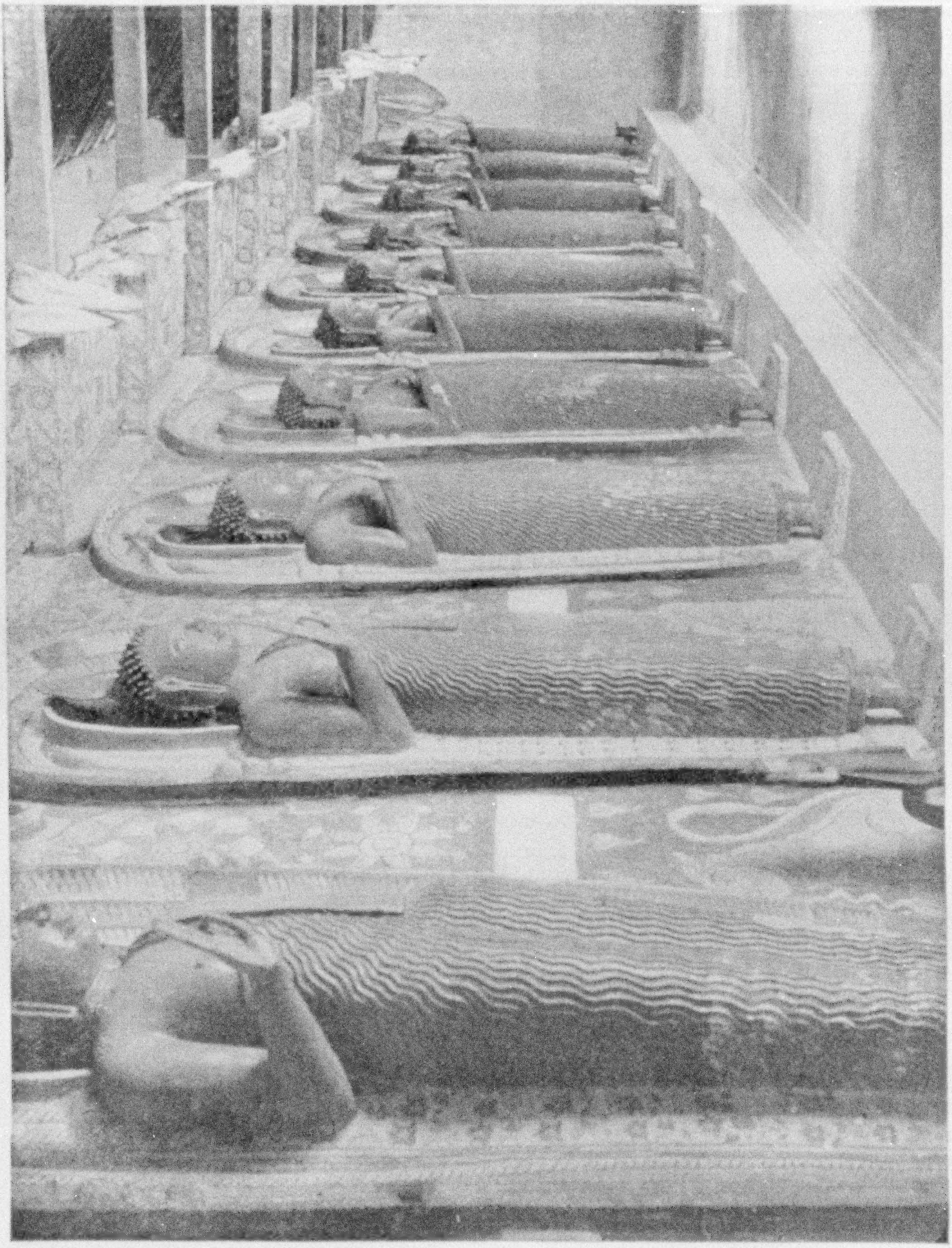


Photo from Dr. Alexander Graham Bell

TAMIL WOMEN AND CHILDREN



IMAGES IN OUTER CORRIDOR OF THE BUDDHIST TEMPLE AT KELANI, A SUBURB OF COLOMBO brayed them in mortars, or tortured them in gentler ways, or set them to work building palaces for their captors.

The best excursion from Nuwara Eliya is to the summit of Pidurutallagalla, or "Pedro" for short, which rises from the other side of the golf links a steep 2,000 more feet in the air. The strenuous ones walk up a well-chosen path, with benches at the best lookout points; the wise conserve their wind by riding in rickety chairs, and the start is always made before daybreak in order to reach the summit at sunrise.

It is an enchanting trip at dawn up through the forest of rhododendron trees, bearing many orchids, with thick mosses and hanging mosses glittering with the heavy dews. From the cairn on the open summit (8,296 feet) the eye sweeps over mountain tops and green hills down to the lowland plains and the sea. Adams Peak lies below one, and the hazy ocean lies around the great relief map. In a few minutes the distances and the lowlands are lost in the heat haze of the day.

WONDERFUL RUINS AND CAVES

One of the most beautiful drives in Ceylon is the 12 miles from Kandy to Matale, and thence on down to Nalanda and Dambool, at the edge of the low country that constitutes the northern half of the island. Every hill is striped with tea bushes, and avenues of pepper, tamarind, and rain trees shade the perfect roads that pass cacao plantations by the mile.

One stops outside Matale at the Alu Vihara, in the shade of and hollowed out in the ledges of a most remarkable group of detached rocks. There is an image of the sleeping Buddha some 18 feet long and a great footprint in the rock. In 90 B. C. the king convoked the assemblage of priests and bade them reduce to writing all the teachings of the Buddha, which up to that time had been handed down orally, the convocation of priests in every rainy season repeating the teachings day after day in unison, and in that way keeping pure the version brought to the island by the missionary prince Mahindo, son of the Emperor Asoka, the Constantine of Buddhism.

At Dambool, 60 miles from Kandy, there is a great outcropping of gneiss, which slopes steeply upward for 600 feet on one side and rises as a sheer precipice from the plain on the other face. An undercut ledge near the summit of the rock face was availed of 2,000 years ago by a hermit, and a fugitive king, whom he sheltered in the cave home, later fulfilled his vows and excavated a vast chamber in the rock and two smaller caves and richly endowed this religious establishment. There is a fortified gateway as entrance to the high terrace of a ledge, which holds a bell tower and a bo-tree.

In the large cave cathedral there is a heroic rock-cut image of the Buddha standing on the long altar table of living rock, and 53 seated images meditate in the moist perfumed air.

A central dagoba is cut in one piece with the solid floor, and the rock roof and inner walls are painted with religious subjects in a strangely broad and simple, almost primitive, style that one would not be surprised to find in an old Tuscan monastery (see pages 148 and 149).

The procession of saints, each with a golden nimbus, would be recognized as the work of a brother, had Giotto or Cimabue ever come to Dambool. The fronts of the caves are closed in with walls, and the small shrines have dirty Nottingham lace curtains, tawdry ornaments, and greasy brasses that greatly detract from the impressiveness of the place.

From the summit of Dambool rock one sees only level jungle to north and east and west, Sigiri's rock fortress rising like a lighthouse from the unbroken green.* There are 40 miles of level carriage road between two walls of foliage, with only a dreary village here and there, all the way to Anuradhpura. The plains seem hot and steamy to one coming down from the cool air of the hills, and in the old posting days we had to leave Matale before daylight to accomplish the 70-mile drive at dusk, changing horses six times. Now, with a railway direct from Colombo, one can get there in six hours,

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* See article "Archeology in the Air," in the NATIONAL GEOGRAPHIC MAGAZINE, March, 1907.

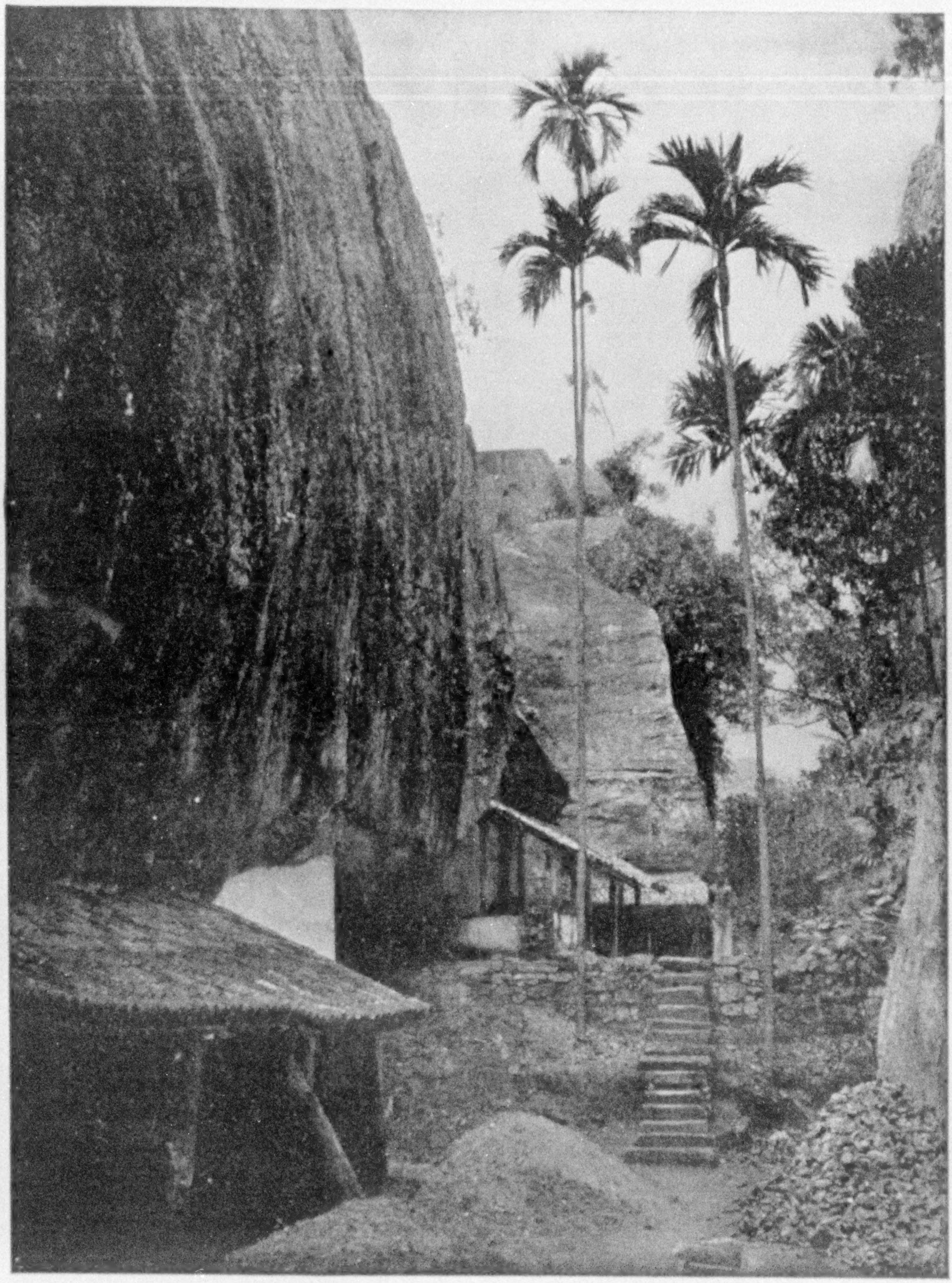


Photo from Eliza R. Scidmore

THE ALU VIHARA, A CAVE TEMPLE AND MONASTERY NEAR MATALE, WHERE THE BUDDHIST TEACHINGS WERE FIRST PUT IN WRITTEN FORM, ON PALM LEAVES, IN THE FIRST CENTURY B. C. (SEE PAGE 145) or by automobile it is only a morning's run over roads worthy of a London park.

One admirable English officer gave his life, 50 years of it, to perfecting the road system of Ceylon. He constructed 3,000 miles of highways, maintaining a standing army of 3,000 or 4,000 road coolies specially trained to that work. It was wisely ordered from the first that every adult male should give six days' labor, or its equivalent tax, for road-making. That policy, pursued since 1848, has resulted in a perfection of such means of communication as fills an American with envy.

One meets nothing all day but Tamils from the Jaffna end of the island or the Indian mainland, walking to the hills for employment on the great estates—poor, spindly, weedy looking creatures of inkiest blackness, to whom the Ceylon hill country is like an America of opportunity and high wages. The average pay of 10 and 16 United States cents a day on the tea plantations is three times as much as they can earn in India; and, in addition, they are housed, given medical care, and schools provided for their children.

Once we saw an elephant devouring the yellow flowers of a mango tree, but his keeper was lolling in the shade; and again a jungle cock flashed across the road to the shelter of bushes hung with the gorgeous red and yellow *Gloriosa superba,* the most splendid tropical flower that grows, and quite deserving its extravagant name. Butterflies danced in clouds down the empty road—large tropical butterflies with great wings of prismatic sheen, and the common little yellow cabbage butterflies that are one of the three things found in every country and climate the world over, the others being the Norway rat and the Chinese.

THE GLORIOUS CITY OF ANURADHPURA

All this lowland half of Ceylon was once thickly populated, and the city of Anuradhpura, founded at the time of the Ayan invasion, 2,500 years ago, was one of the richest and greatest cities of the East. Its real history began with the arrival of the Buddhist missionaries from India in 245 B. C. and their planting of the sacred Bo tree, a branch from the tree under which Buddha sat when he attained Buddhahood. There has been continuous record kept of the ceremonies and festivals connected with the tree from that day to date—when walls were built, when branches were lost, of the festivals of lanterns at the watering time in each dry season—princely monks minutely

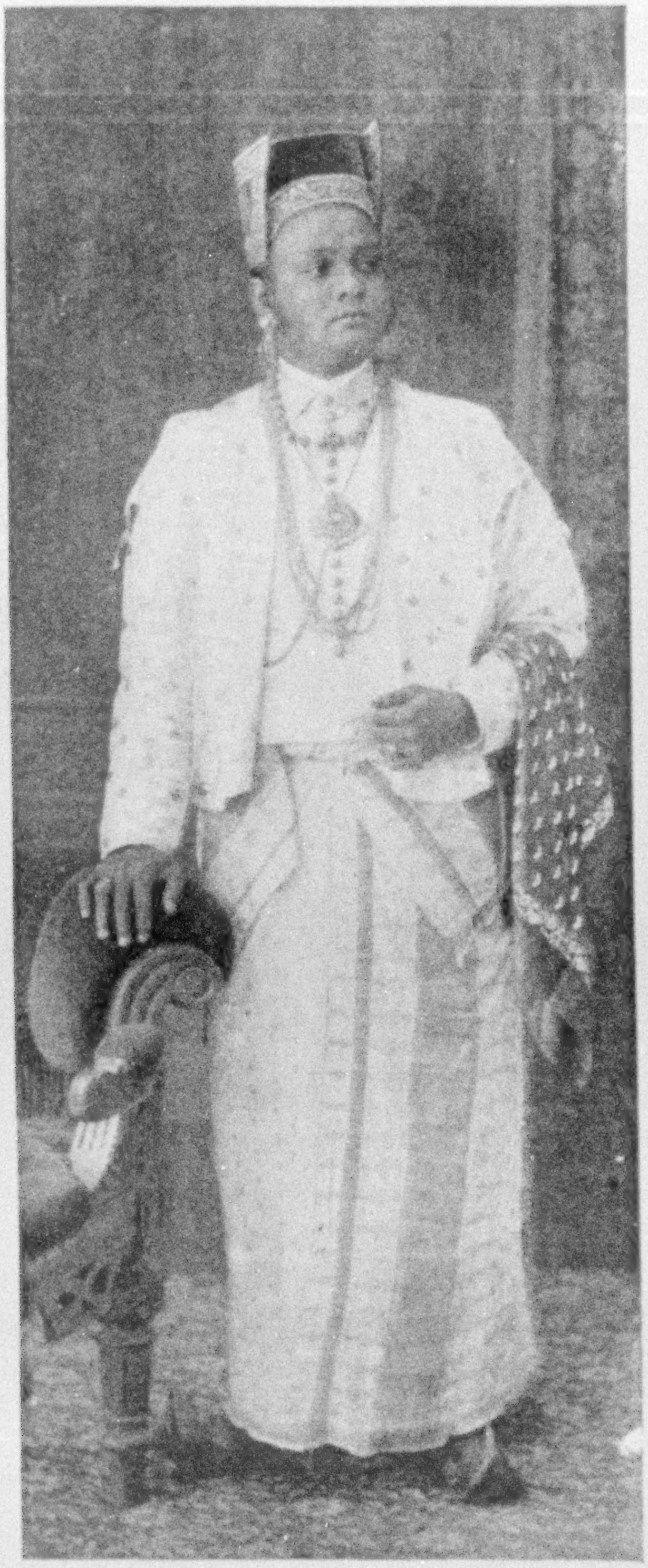


Photo from David Fairchild

A KANDYAN KING: CEYLON

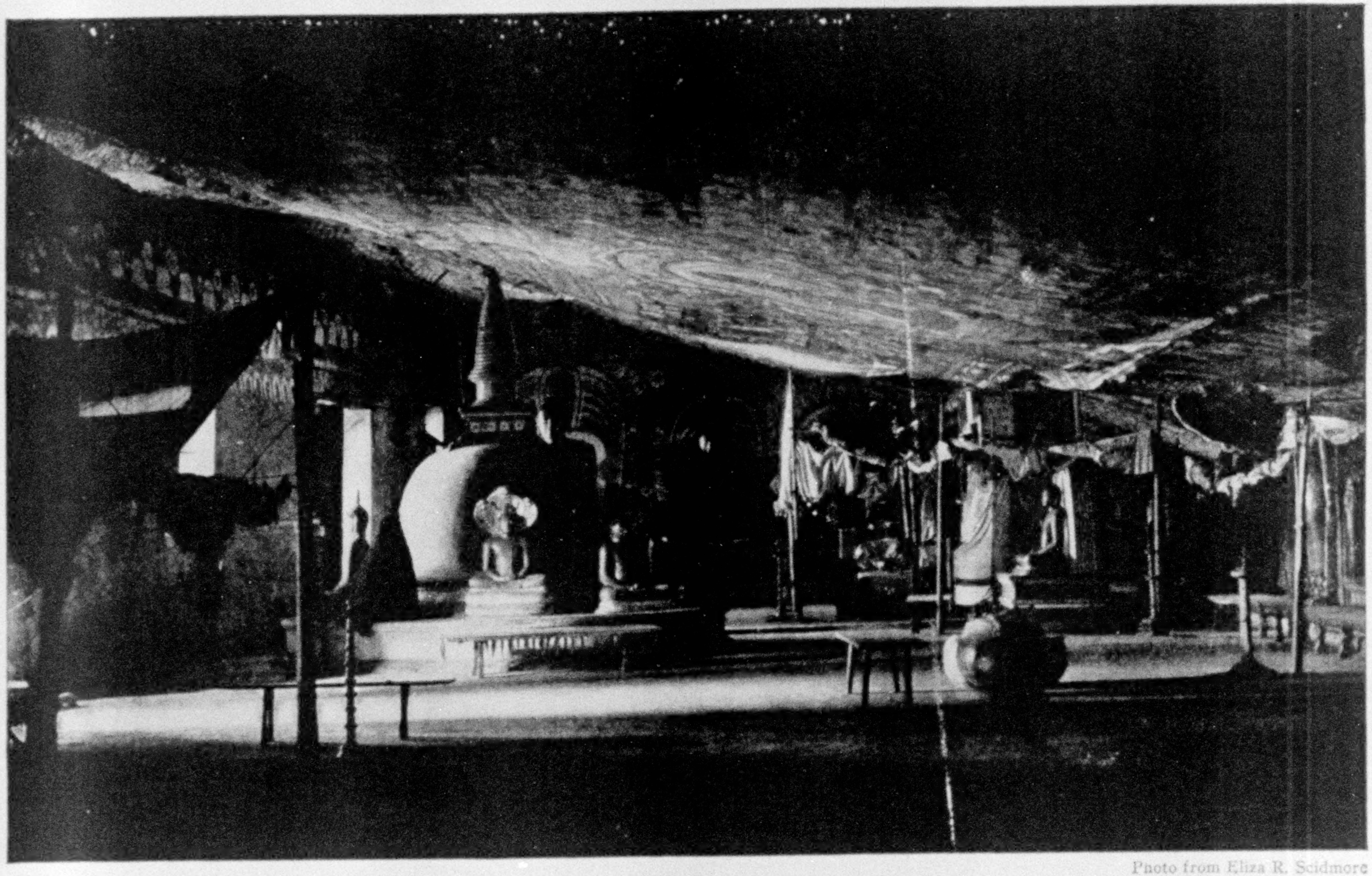


Photo from Eliza R. Scidmore

A NATURAL CAVERN IN THE GREAT ROCK OF DAMBOOL, WHERE KING WALAGAMBAHN TOOK REFUGE IN THE FIRST CENTURY B. C.: ENLARGED LATER

Frescoes on walls and natural rock ceiling nearly 2,000 years old. This cave temple measures 150 feet by 60 feet, and the roof is 23 feet high at the entrance. The large dagoba is solid rock, still joined to ceiling and floor

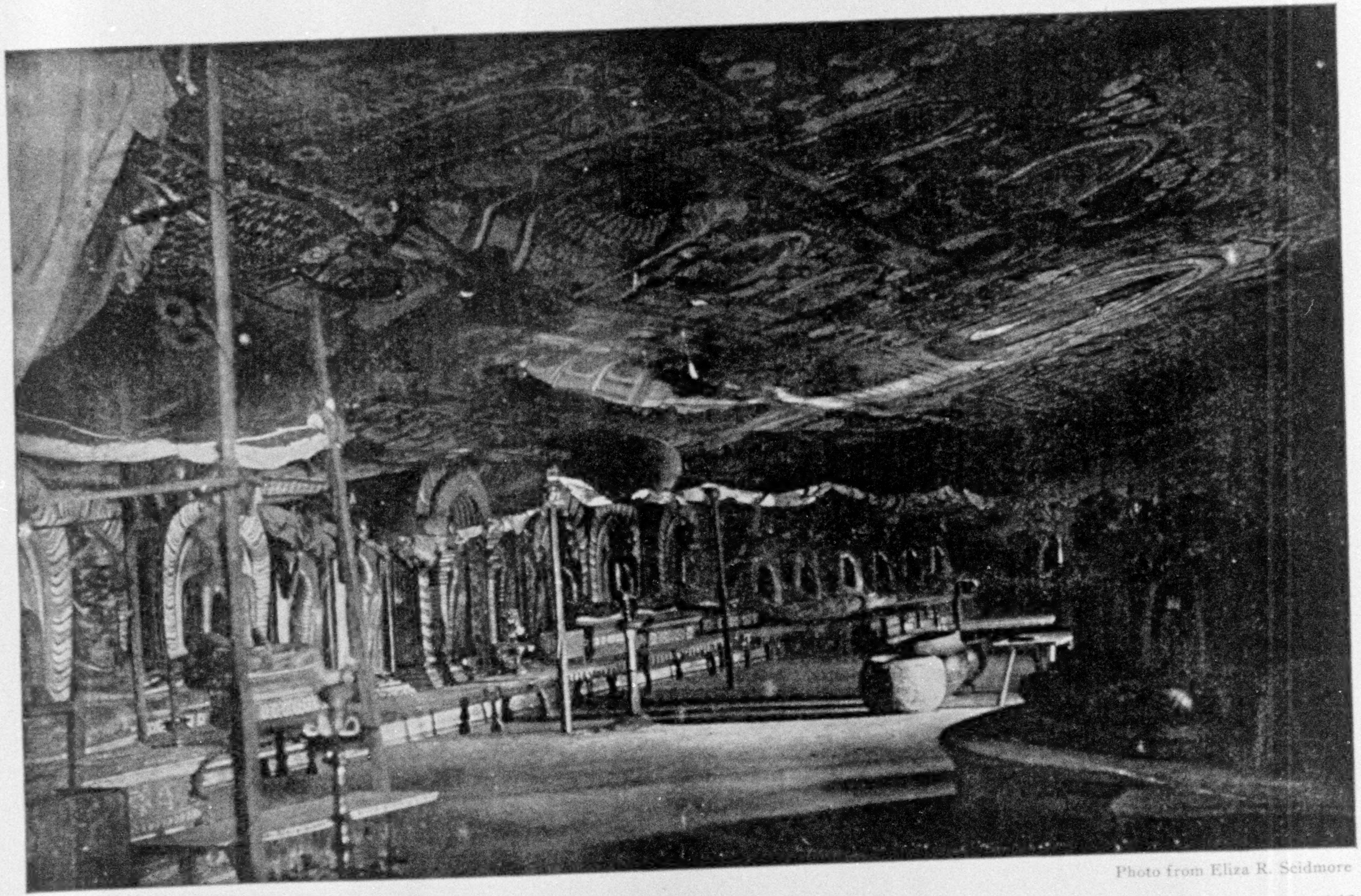


Photo from Eliza R. Scidmore

REAR OF THE GREAT CAVE TEMPLE IN THE ROCK OF DAMBOOL, WITH STATUE OF KING WALAGAMBAHN AND 50 IMAGES OF BUDDHA

The rock walls and roof are entirely covered with frescoes of historic scenes in Sinhalese history (see page 145)

XUM

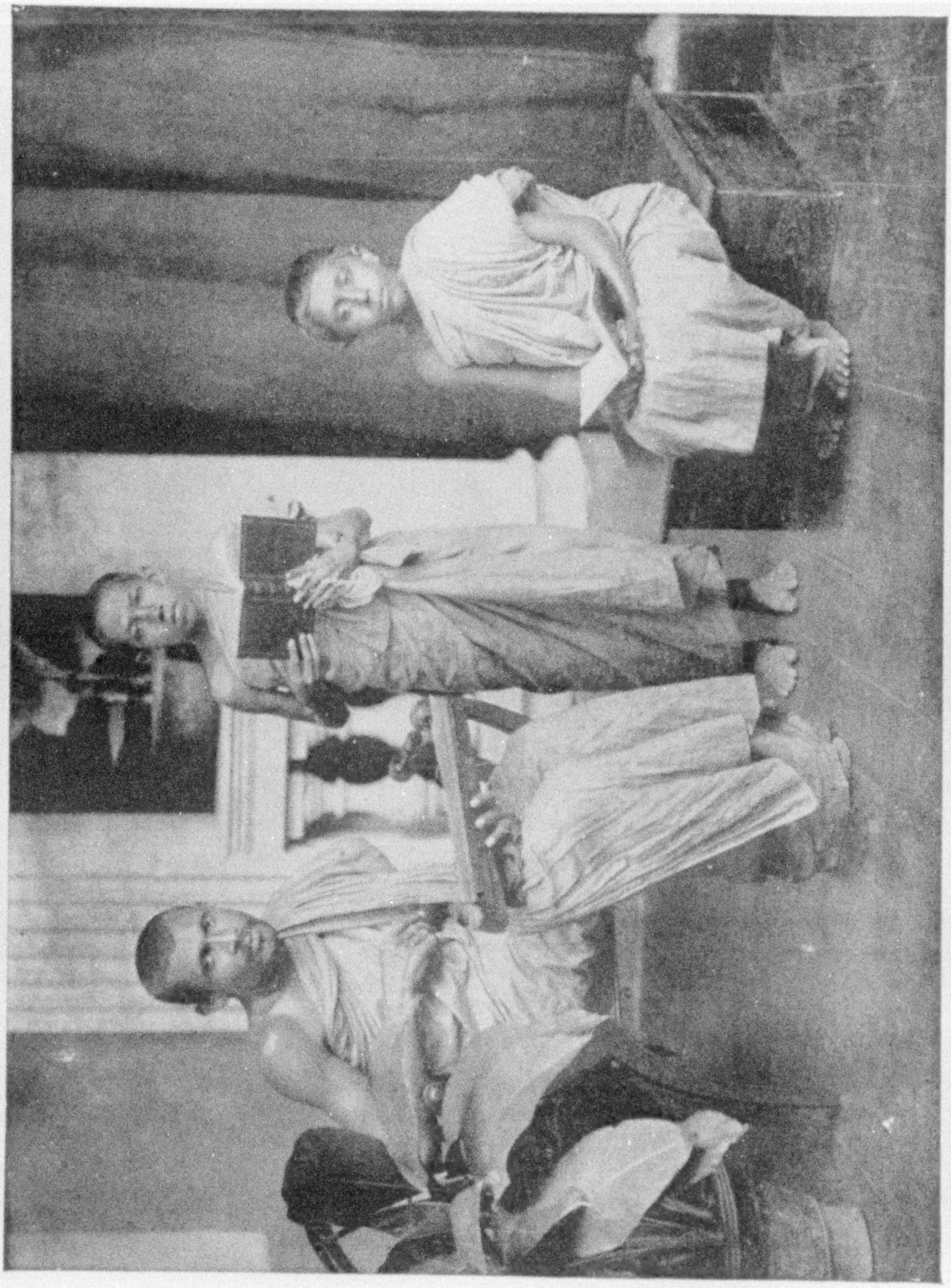
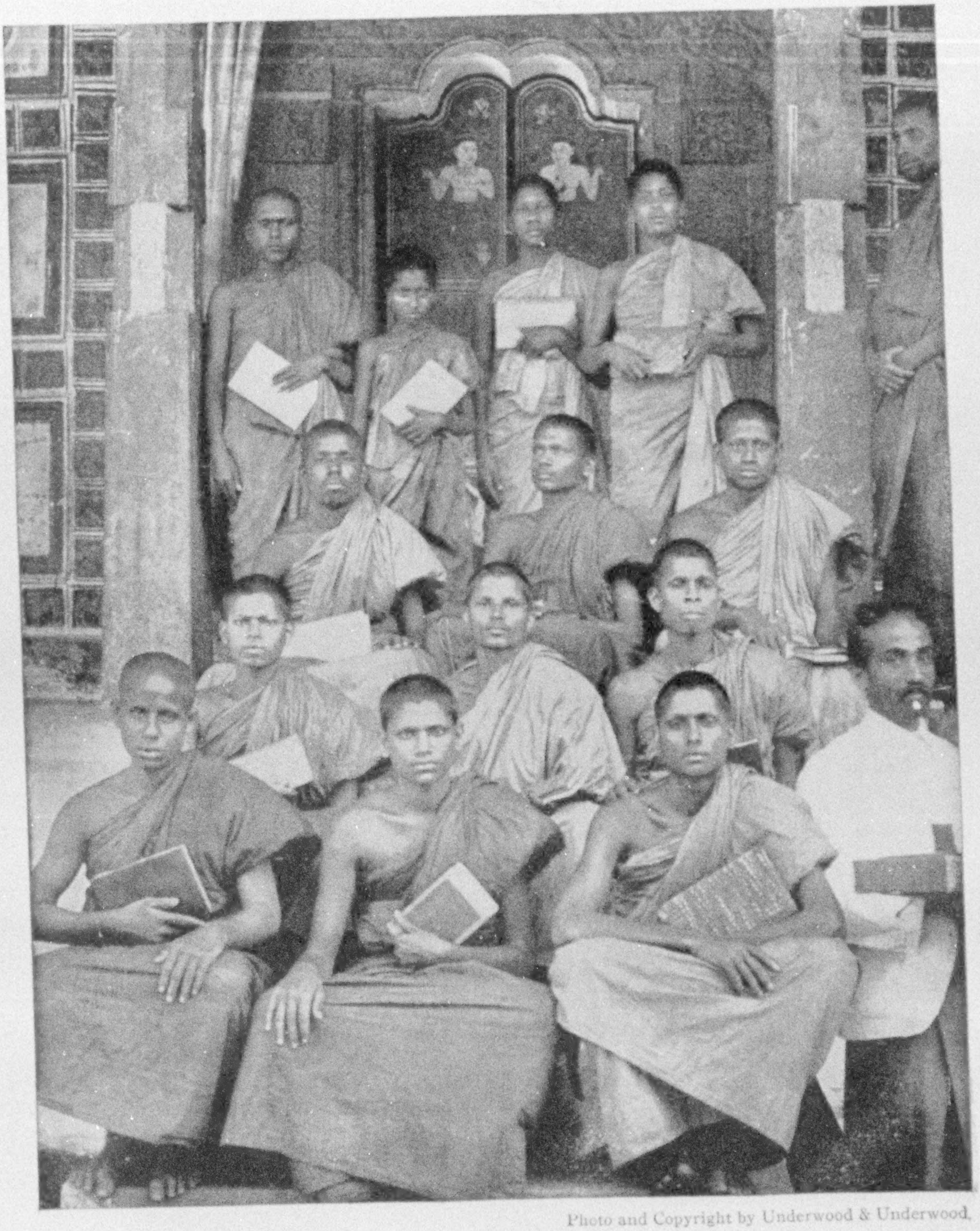


Photo from Dr. Alexander Graham Bell

PRIEST AND ACOLYTES OF THE TEMPLE OF THE TOOTH AT KANDY (SEE PAGE 117)



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STUDENTS FOR THE BUDDHIST PRIESTHOOD AT THE DALADA MALAGAWA, TEMPLE OF THE TOOTH: KANDY, CEYLON (SEE PAGE 117)

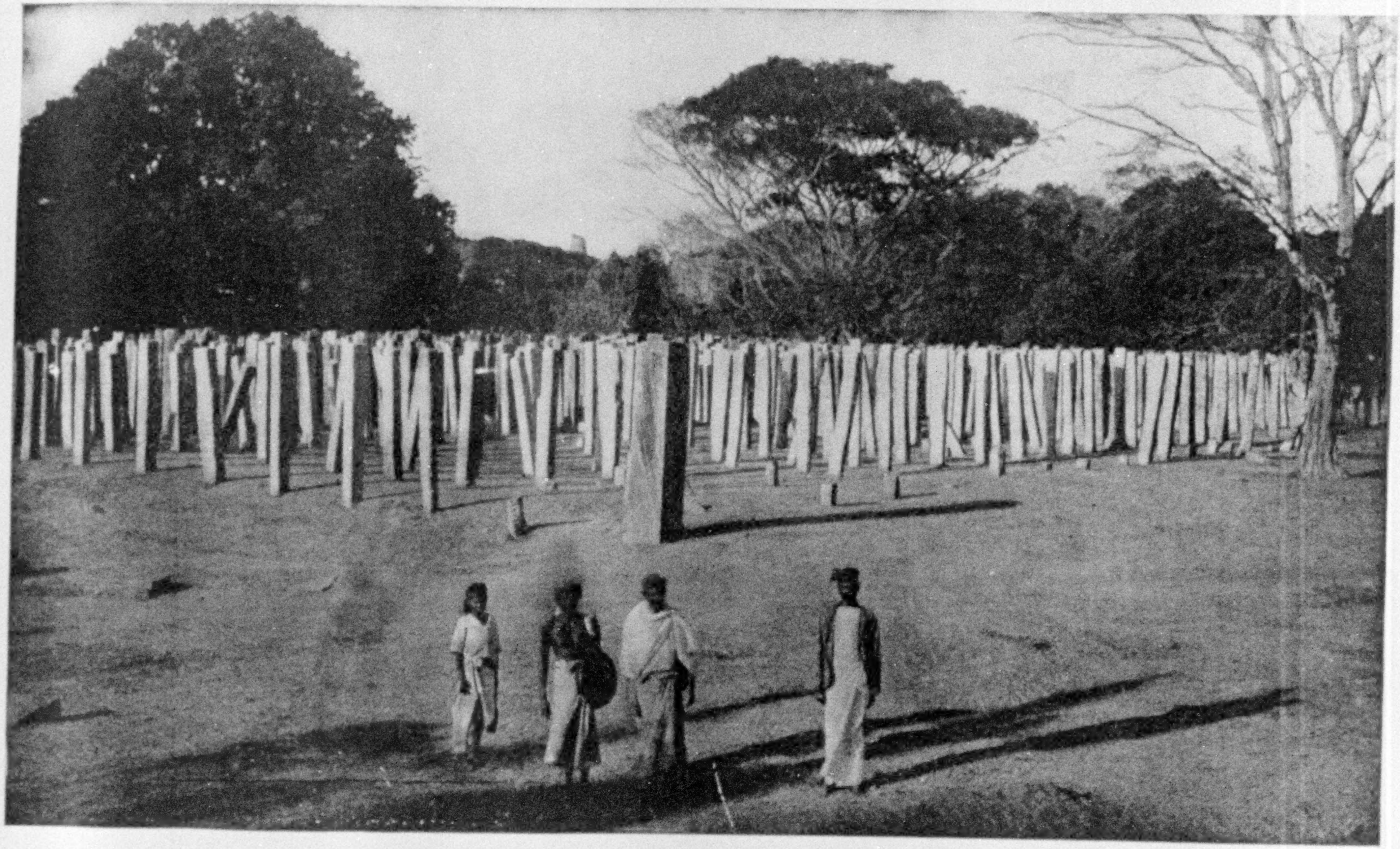


Photo from Dr. Alexander Graham Bell

REMAINS OF THE BRAZEN PALACE AT ANURADHPURA, A BUDDHIST MONASTERY

It was nine stories in height, 100 cubits square, and rested on these 1,600 granite columns. It was covered with brazen tiles, and was built by King Dretthagamini in 164 B. C. A great civilization was at its height in Ceylon when Christ was born. Anuradhpura, the capital, occupied about 100 square miles in a fertile plain; it harbored 96,000 Buddhist priests. Water was brought from the mountains, 40 miles distant, in a huge canal and stored in large artificial lakes.

chronicling Sinhalese history at the one monastery down to the time of the British conquest.

The sacred Bo tree has always been an object of reverence and pilgrimage, and it never suffered during the many wars and invasions. It stands in a large enclosure with an entrance gate, and looms up a mountain of dancing, dark-green, glittering leaves.

Triple terraces, or altar-tables, surround the mighty trunk and protect the Tree of Wisdom, as at Buddh-Gaya, from the extraordinary offerings of the faithful. A legion of wanderoo monkeys live in the tree and subsist on the fruit and flowers and food-offerings of pilgrims. Languid brown priests receive more solid contributions and permit Burmese worshipers to daub ochre and gold leaf on the walls.

A grove of its descendants surrounds the original tree, and each shining, heart-shaped leaf, with its long, tapering, tendril, perpetually spins and trembles on its long foot stalk—trembles in reverence for the one who became the Buddha beneath its branches. Each leaf is a prayer, a sacred talisman, and pilgrims prostrate themselves before a fallen leaf and reverently lift and carry the treasure away.

When I went back to the tree, late on a rainy November afternoon, to gather more of the great leaves—which are two and three times the size of the leaves of the Buddh-Gaya tree—only a mite of a Tamil horse-boy from the resthouse went along. The troops of monkeys fled from the tables of offerings to the tree branches and sat there staring and gibbering.

When I stooped to pick up a leaf they dropped to the terraced altar. When I moved they moved, dropping down and down, alighting on the stone flags so silently on their pneumatic feet that before one could realize it the court was full of mouthing apes that swung threatening arms, as they hopped nearer and nearer, until flight was best.

When Anuradhpura was a city measuring 16 miles from north gate to south gate, and there were 11,000 houses on that one street, there were palaces and temples and monster dagobas to match; and, after being razed and rebuilt, after several wars it attained its height in the 12th century. At that time the Sinhalese overran southern India and carried their victorious excursions as far as Cambodia; but when the Tamils retaliated, a century later, the whole of northern Ceylon was laid waste. Cities were destroyed, tanks were broken, and the people massacred or carried into captivity. The country soon went to jungle, with a few villages and lone temples existing by the swamps that once were tanks of clear water. British rule has revived the region, roads have been cut through, tanks rebuilt, and the land cultivated once more. With the railway and the rubber boom, and irrigation, the prosperity of the low country is assured.

Along with this economic salvation British archeologists have done an enormous work in uncovering, making accessible, and making known these wonderful monuments of the early century. Mihintale, the sacred pinnacle peak eight miles from Anuradhpura, is strewn over with temples, tanks, shrines, and alcoves where saints and hermits dwelt. Pollonaruwa, 50 miles across the jungle from Dambool, was the capital from the 8th to the 13th century, and in the great area of ruins there are many buildings better preserved than at Anuradhpura, with far more elaborate sculptures (see pages 136, 159, and 160).

The first railway from Colombo to Kandy was opened in 1869, and although immensely profitable to the government, it was forty years before it was continued the 200 miles to Jaffna, at the north end of the island. One looks impatiently at the map where the large islands of Manaar and Paumben are almost joined by the chain of islands known as Adams Bridge—our forefather, it is said, having gone by this route to Mecca to bring Eve to the new home in Ceylon. The passage between Ceylon and Manaar is so shallow that it can be forded, and that between Paumben was once dredged to accommodate vessels drawing ten feet, with such disastrous results to the pearl fisheries that it will probably never be attempted again.

A railway from Ceylon to the Indian

XUM

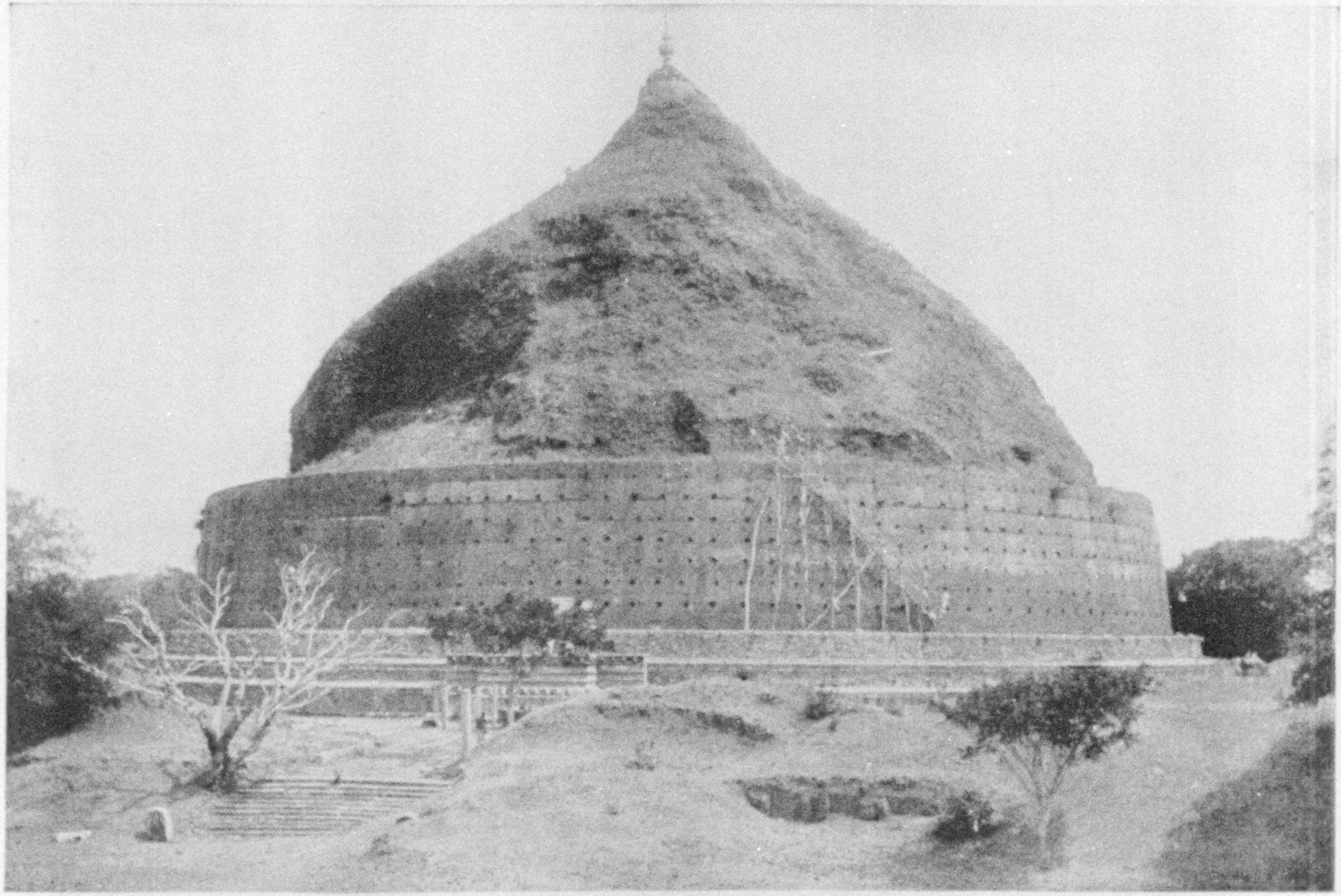
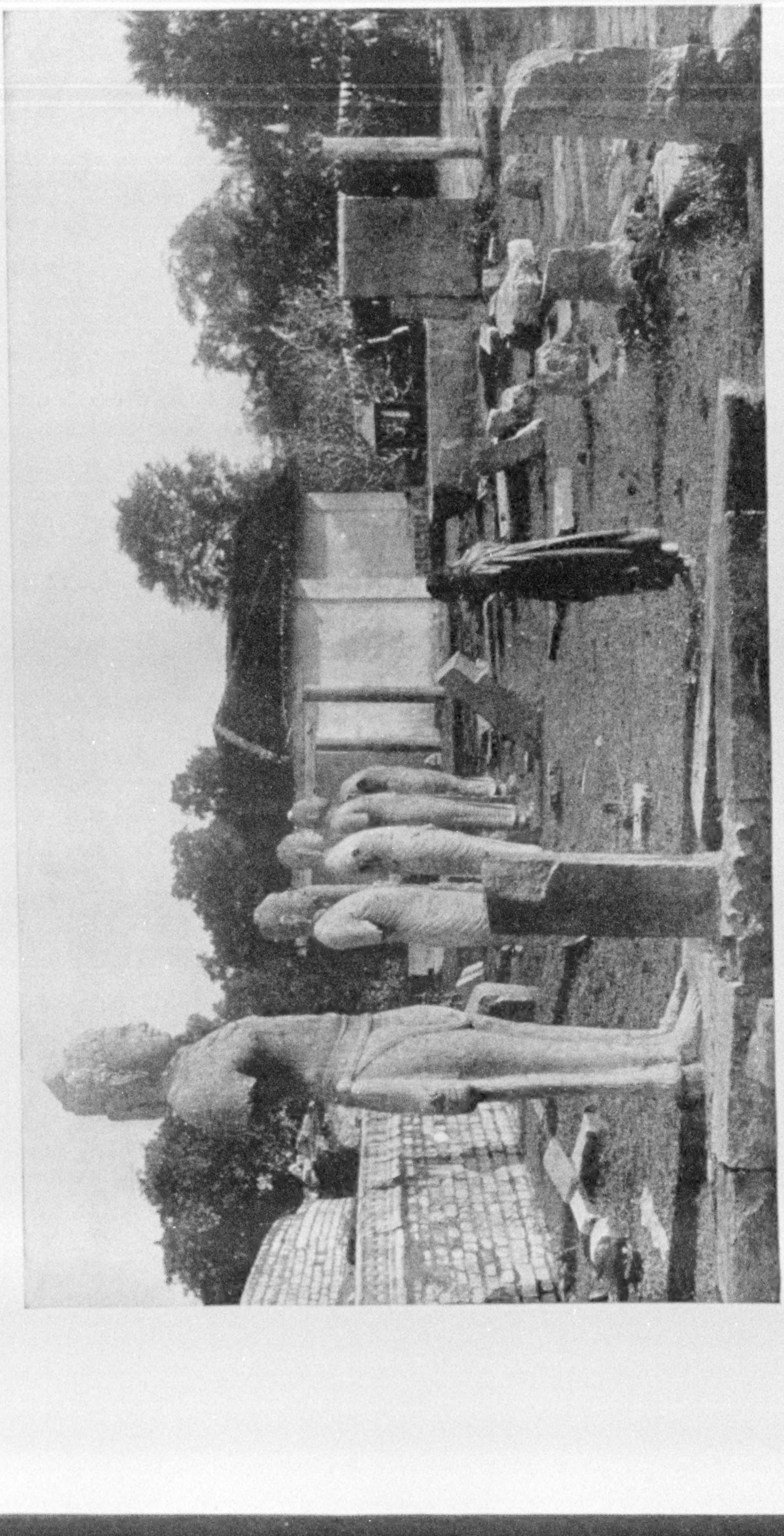


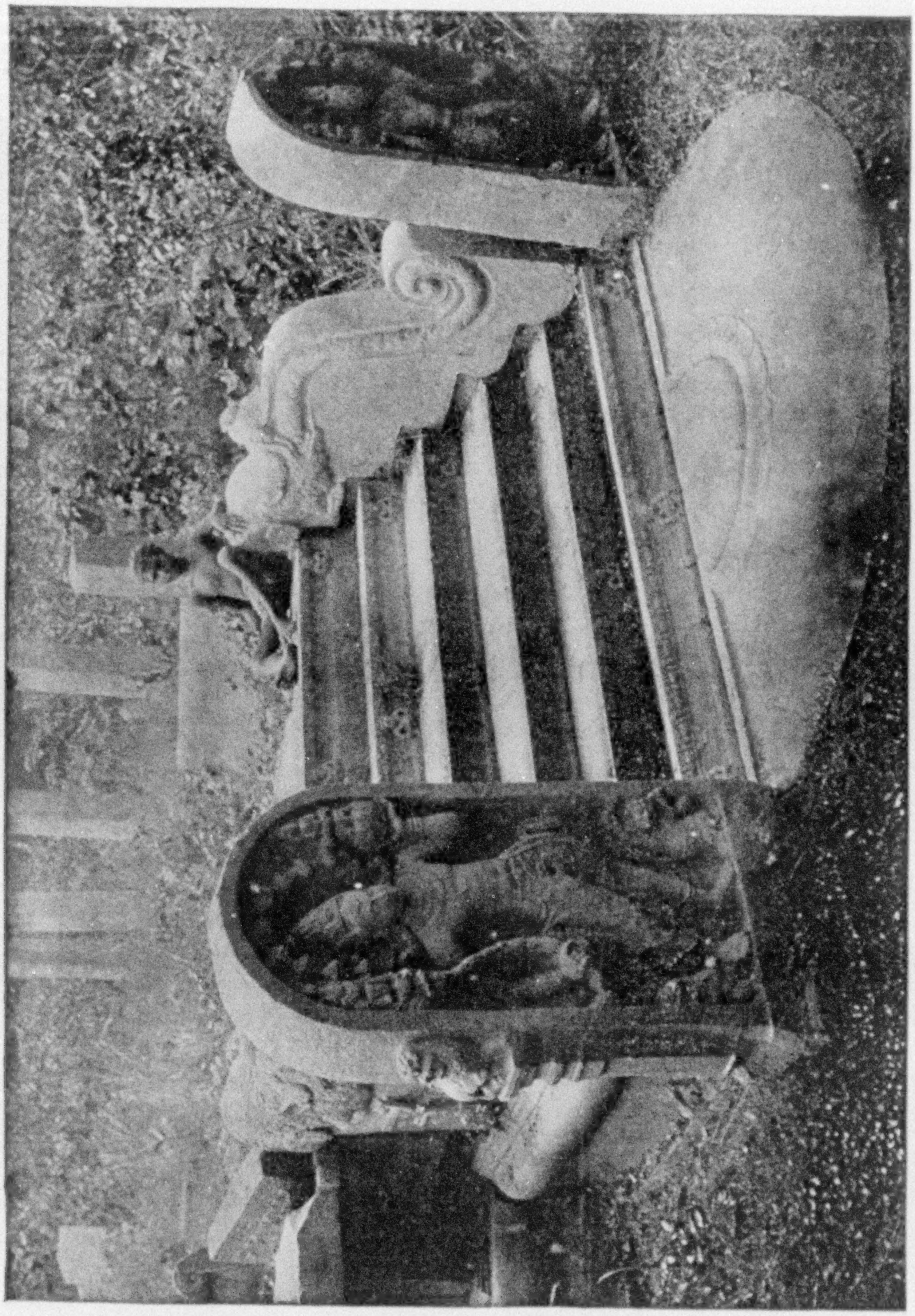
Photo from Dr. Alexander Graham Bell

RUANWELI DAGOBA, ANURADHPURA, A SOLID MASS OF BRICKWORK 200 FEET HIGH

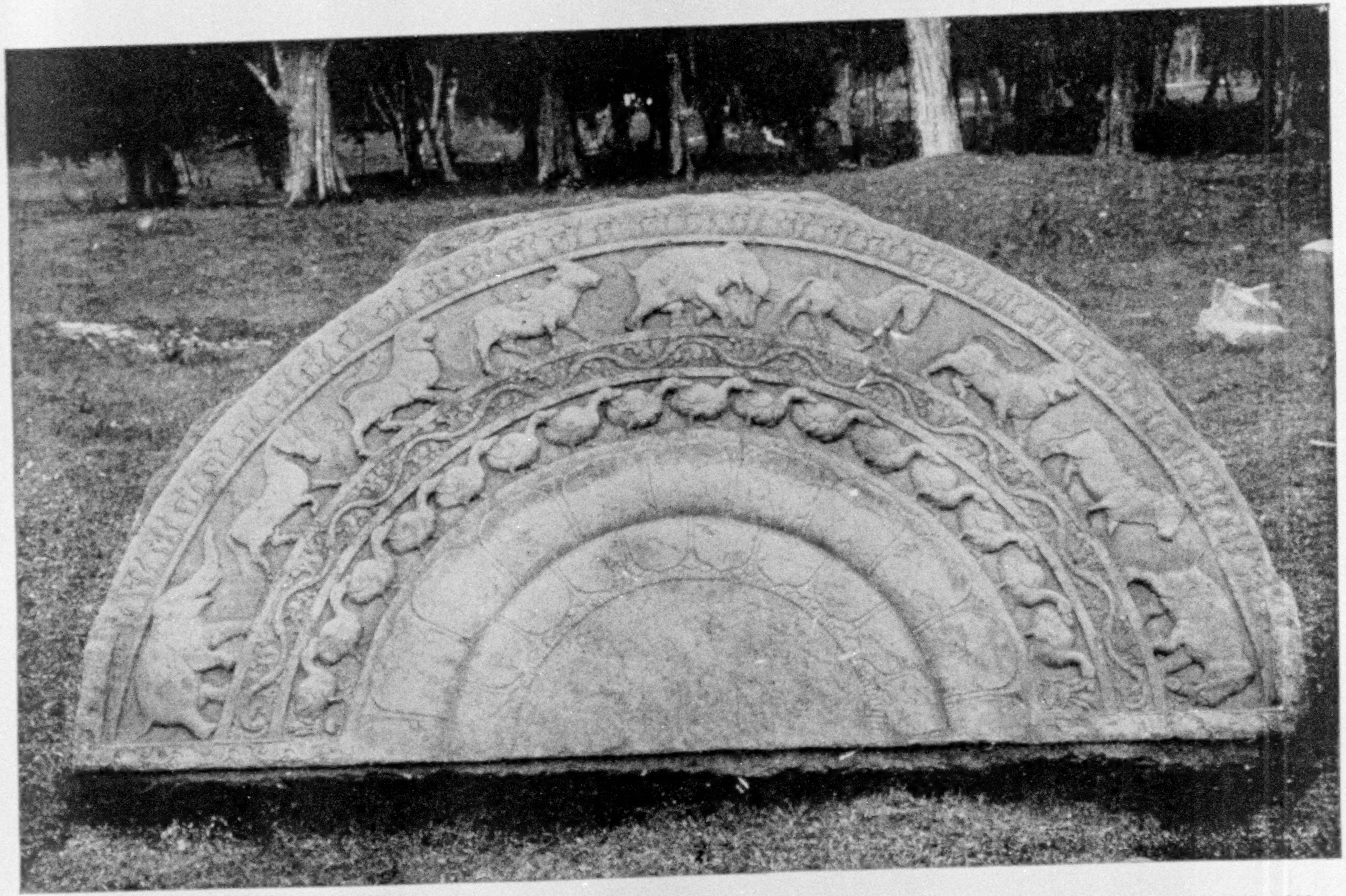
Formerly over 300 feet high, with processions of caparisoned elephants of *Chunam* ranged on the lower terrace, and covered paths on each terrace for festival processions. A great portico or temple covered the main altar or place of offerings. There are four of these huge bee-hives of solid brick in Anuradhpura. They were constructed by kings to commemorate different events. The dagoba shown in this picture contains sufficient brick "to raise 8,000 houses, each with 20 feet frontage, and these would form 30 streets each half a mile in length."



STATUE OF KING DUTTHAGAMINI, THREE BUDDHAS, AND KING BATIYATISSA I, EXCAVATED FROM RUINED HALL AT BASE OF THE RUANWELI DAGOBA, WHICH IS SHOWN ON PAGE 154: ANURADHPURA. EACH STATUE IS ABOUT 10 FEET IN HEIGHT

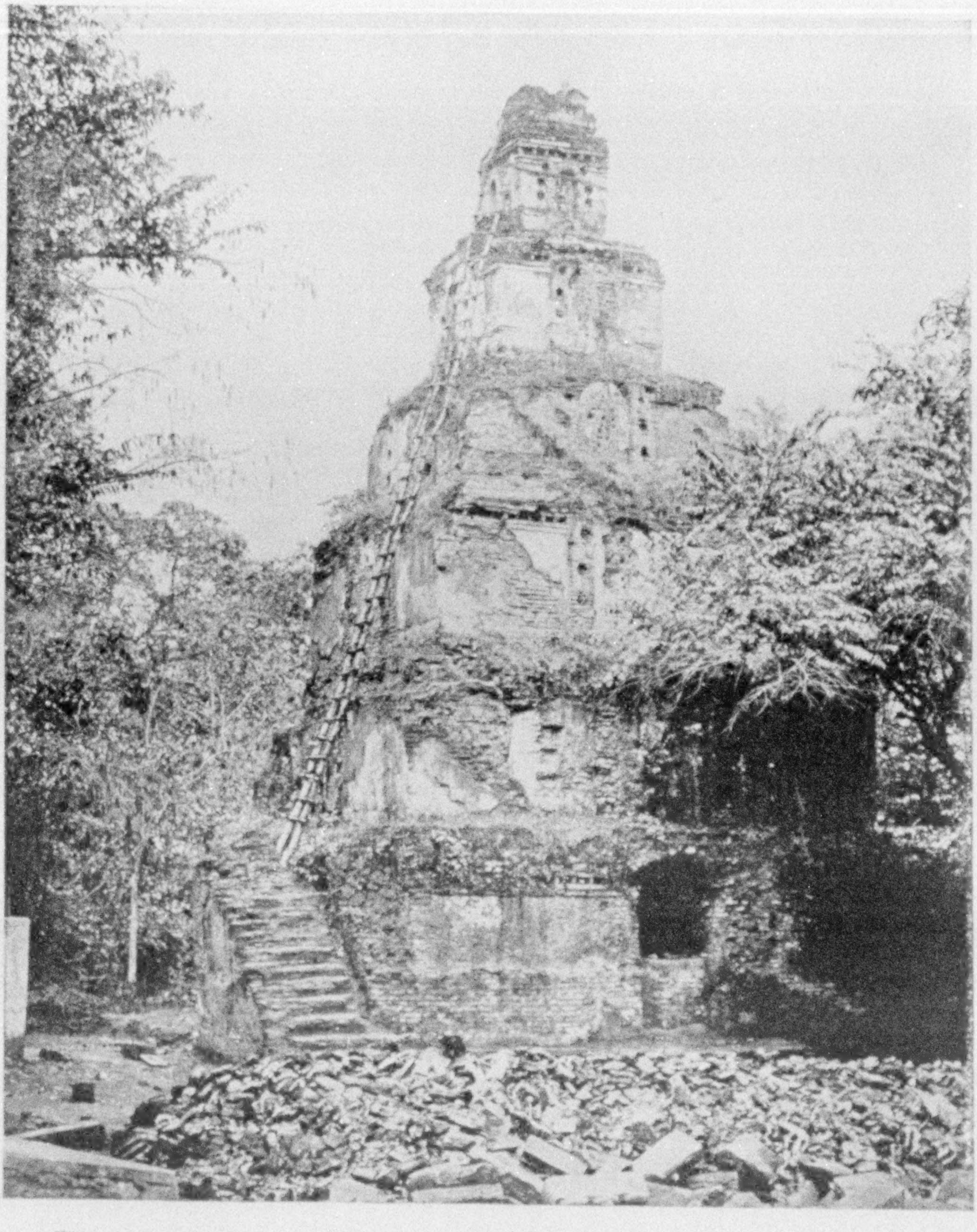


FLIGHT OF STEPS, WITH GUARDIAN STONES AT EITHER SIDE AND "MOONSTONE" AT FOOT OF STEPS: ANURADHPURA



SEMI-CIRCULAR "MOONSTONE" AT FOOT OF STEPS: ELEPHANT, HORSE, LION, AND BULL SCULPTURED ON OUTER RIM, WITH LOTUS DESIGNS AND THE HAUSA, OR SACRED GOOSE, AND LOTUS PETALS AT CENTER

These beautiful semicircular stones, of exquisite design and workmanship, have been found before many of the buildings at Anuradhpura



THE PALACE OF SEVEN STORIES, OR SAT-MAHAL-PRASADA, AT POLONNARUWA

Its origin and purpose are unknown. An outer staircase leads to the second terrace only; inner staircase to second level only

XUM

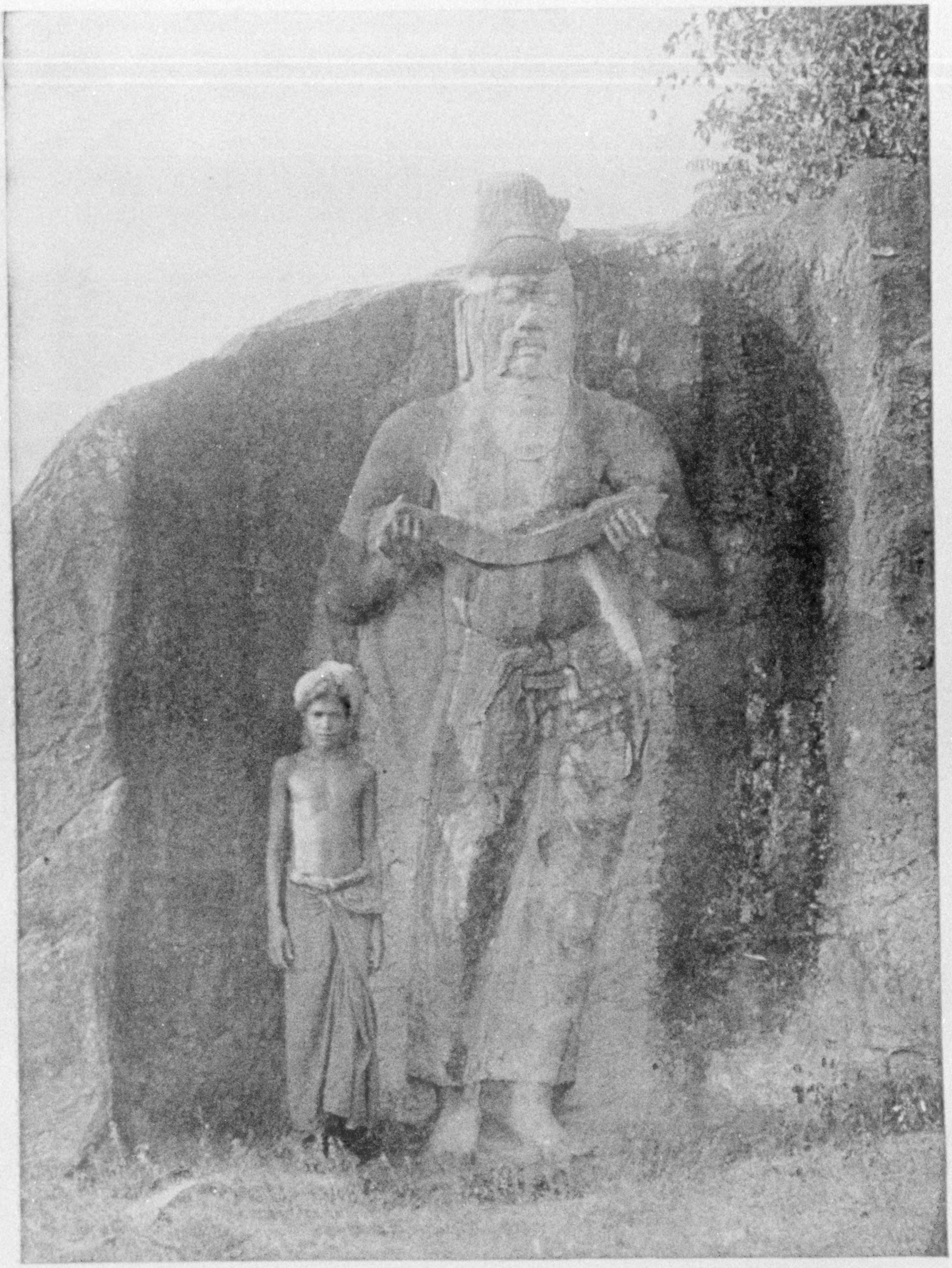
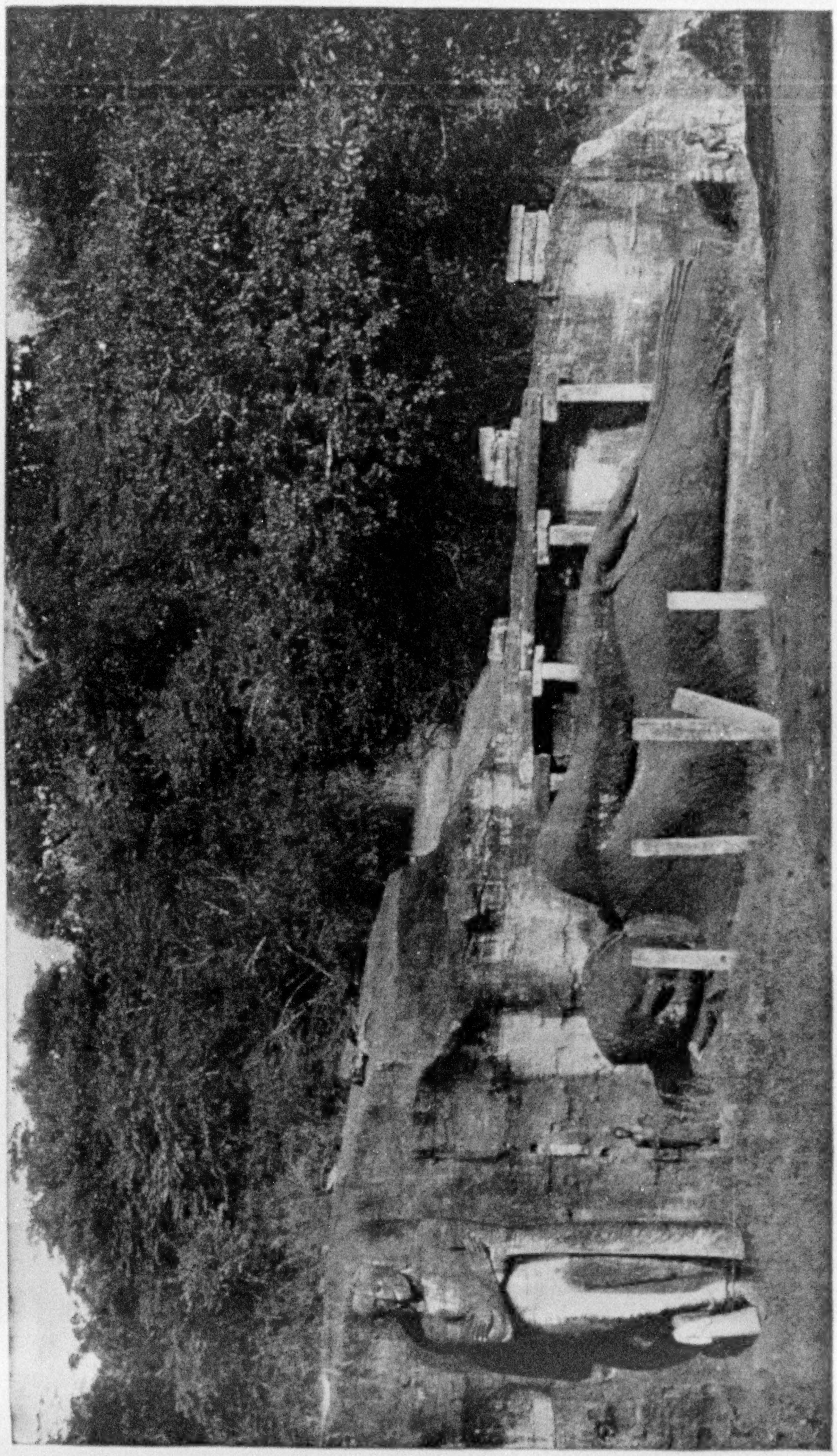


Photo from Dr. Alexander Graham Bell

STATUE OF KING PARAKRAMA THE GREAT, AT POLONNARUWA: CARVED ON THE FACE OF A SOLID ROCK RISING FROM THE PLAIN

He reigned for 33 years in the middle of the 12th century, drove out the Tamils, invaded India, and built this splendid city (see page 163)

XUM

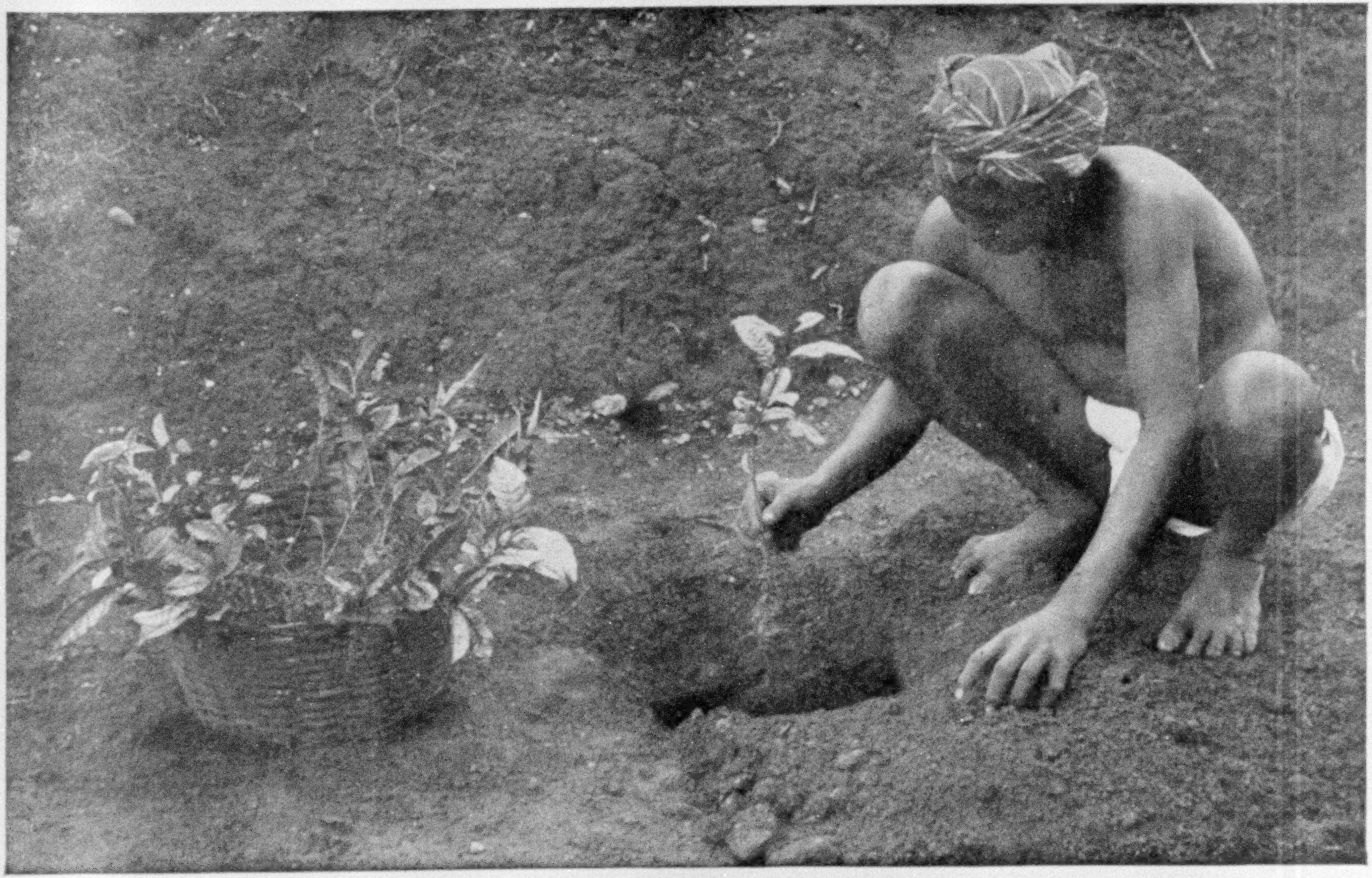


THE SLEEPING BUDDHA, AT POLONNARUWA: CARVED FROM SOLID ROCK

The image is 80 feet in length and was formerly covered by a great temple. These huge statues and images, hewn out of the living rock, are very common in Ceylon

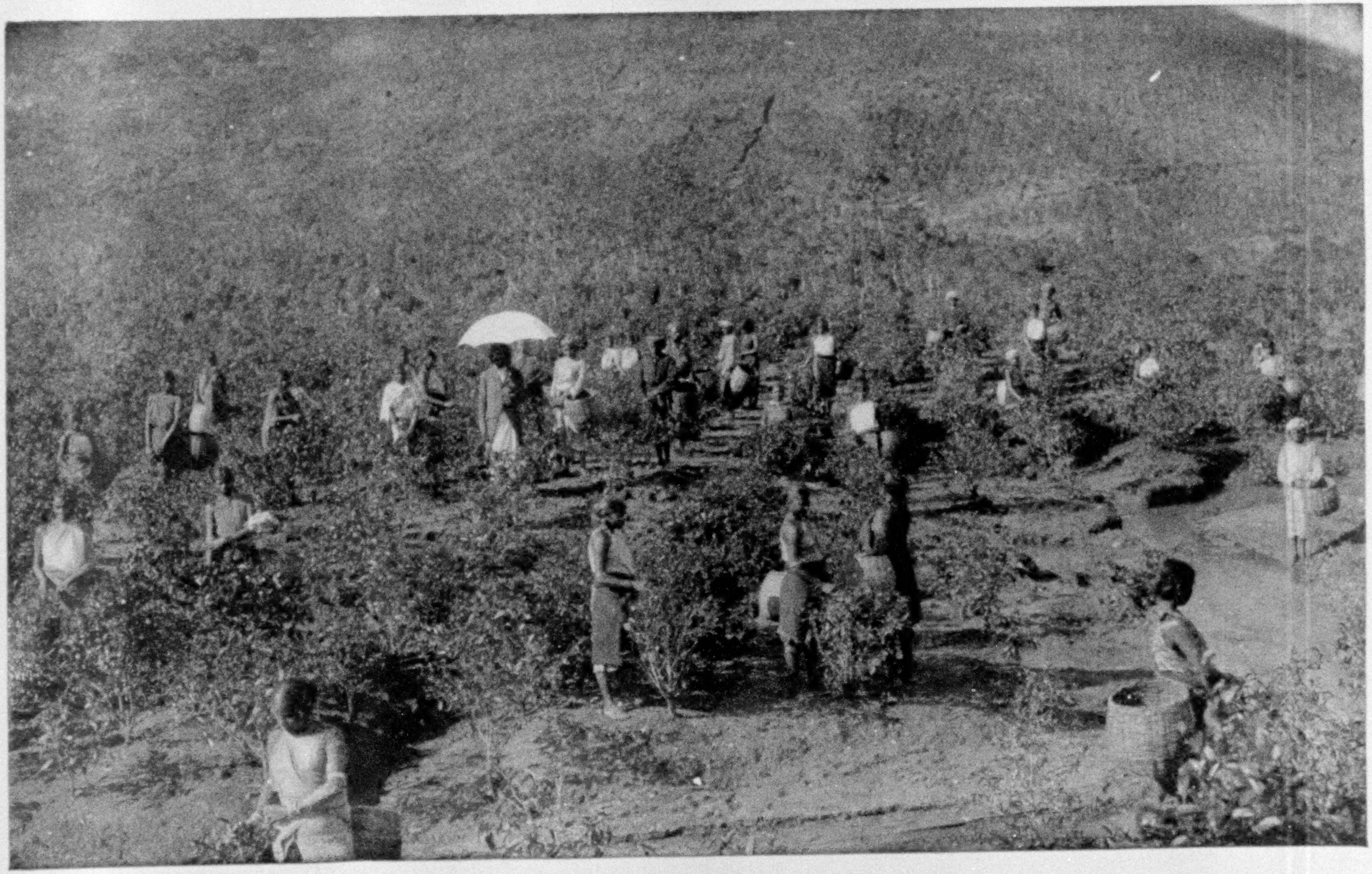
FLOWERS AND BUDS OF THE TEA PLANT

The Chinese say that the virtues of tea were discovered by their remarkable Emperor, Chinnung, 2737 B. C., to whom they ascribe all agricultural and medicinal knowledge. Although many of the products of China were brought to Europe and used by Europeans in very early times, we have no records of the use of tea in Europe earlier than 1588 A. D. The English did not begin to use it to any extent until about 1700, when the price of tea ranged from $25 to $50 per pound.



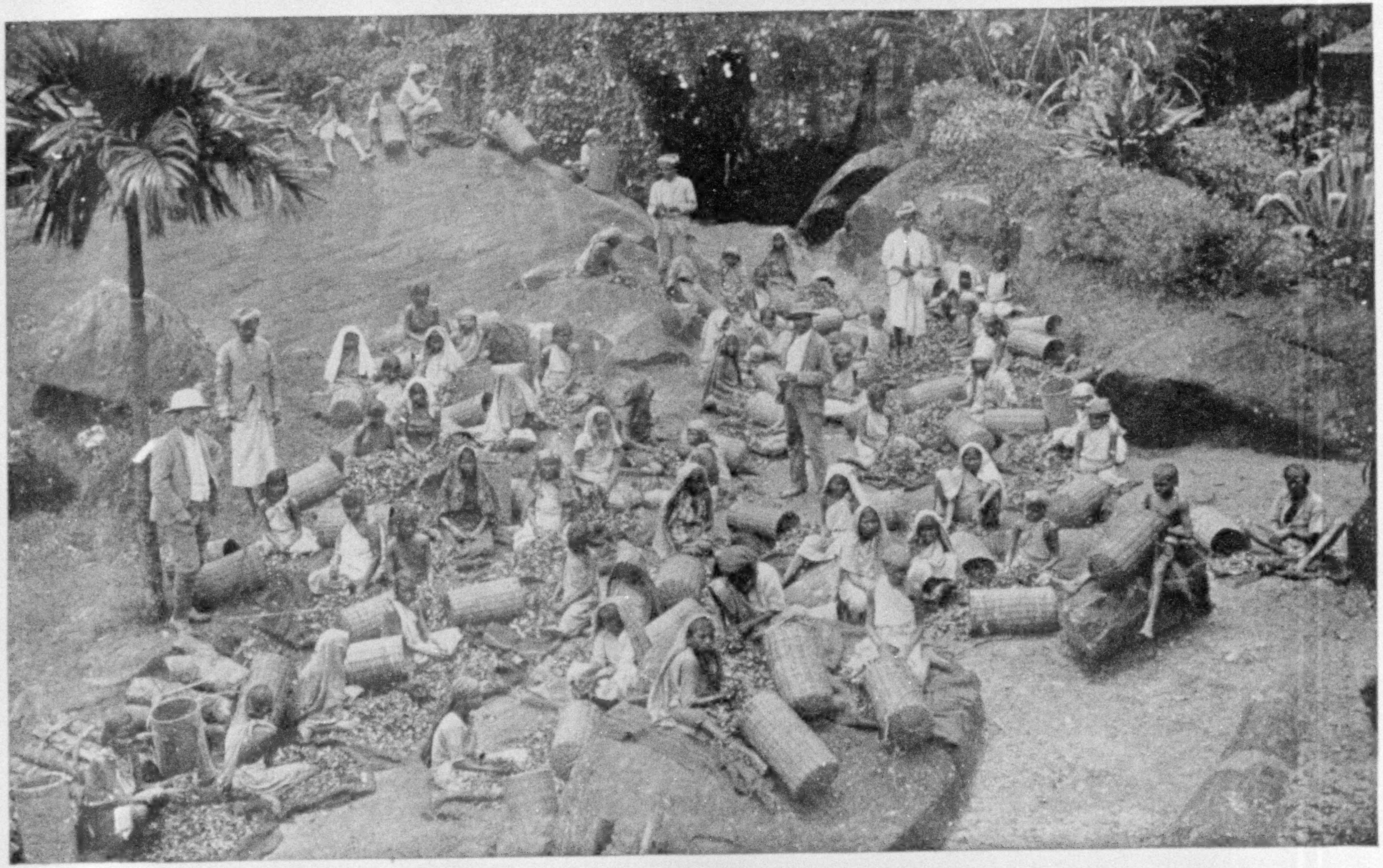
PLANTING A TEA SEEDLING: CEYLON

The tea tree is propagated entirely from seeds, the seed of the tea being slightly larger than a hazelnut. When the seedling is about seven or eight months old it is planted, as shown in this illustration. It grows to four or six feet high in two years, when it is cut down almost to the ground. The first picking does not take place until the third or fourth year. The average tea tree lives for 50 years, though it is said that there are records in China of trees attaining 300 and even 400 years.

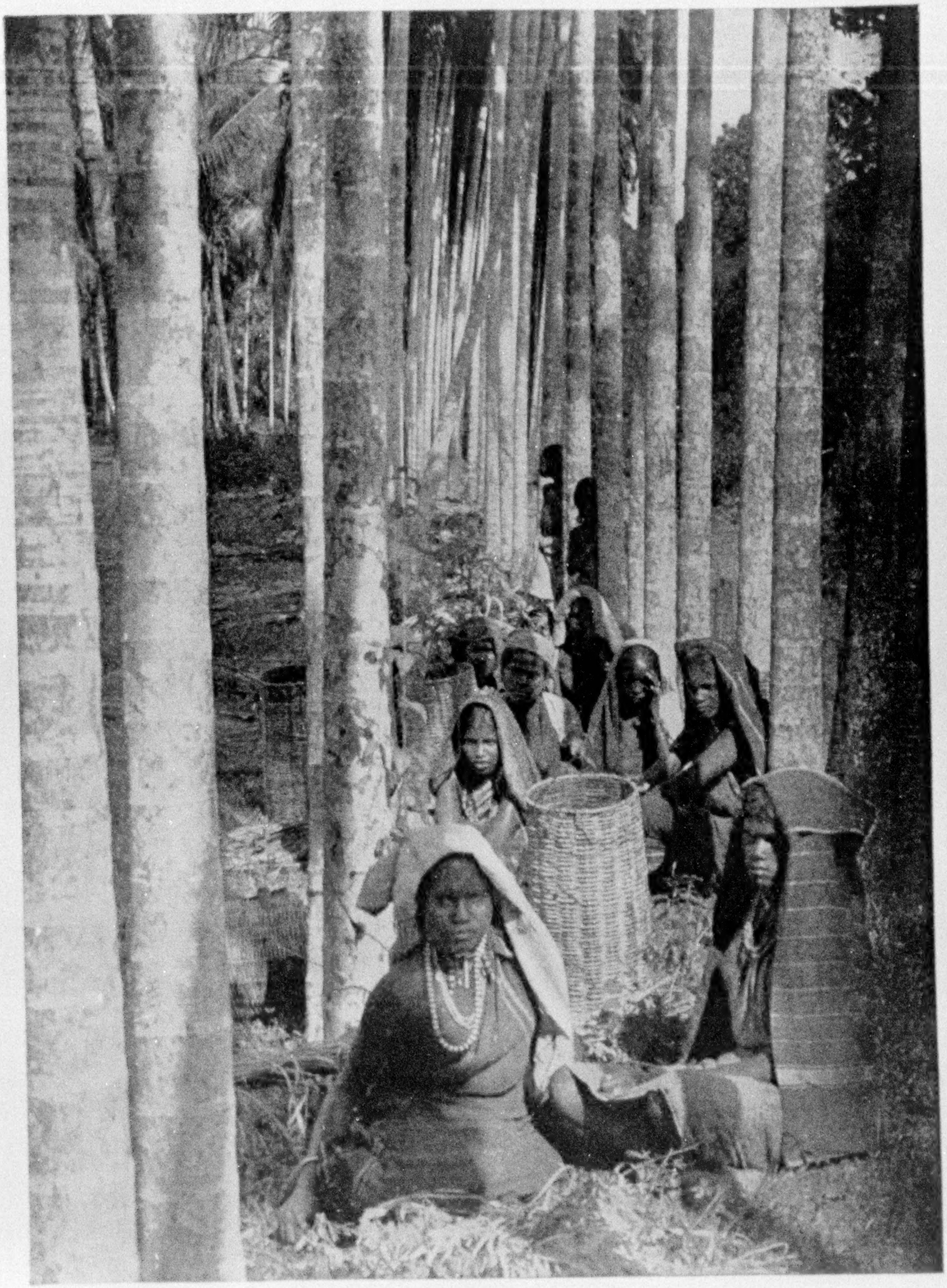


PICKING THE TEA LEAVES

All the picking is done by women and girls, Tamils who come from India to work on the tea estates. The picking begins about the end of April and usually lasts until the end of November. Only the tip of the shoot and soft leaves are picked



SORTING THE TEA LEAVES: CEYLON



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RESTING AT MIDDAY ON A TEA PLANTATION

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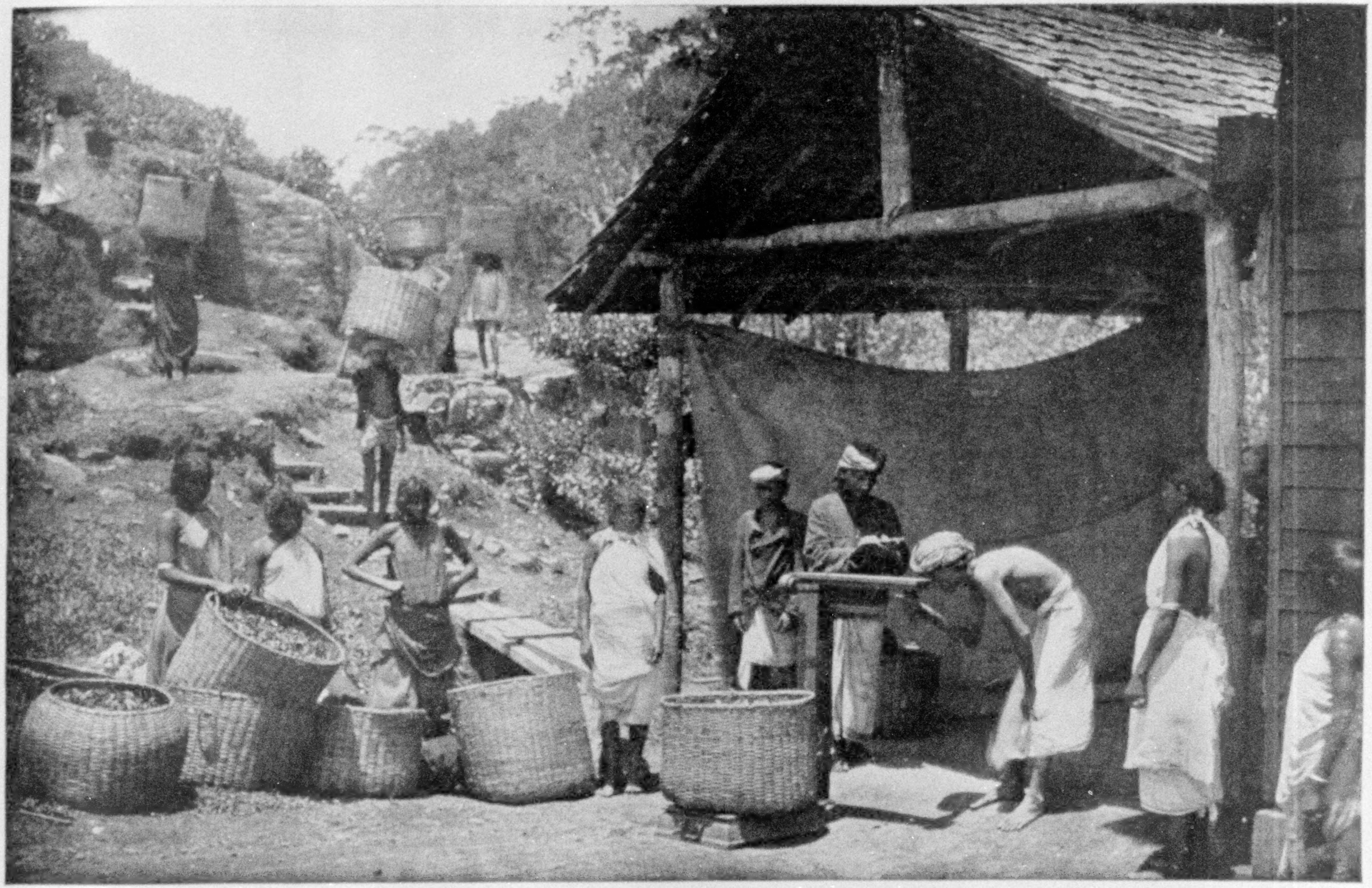
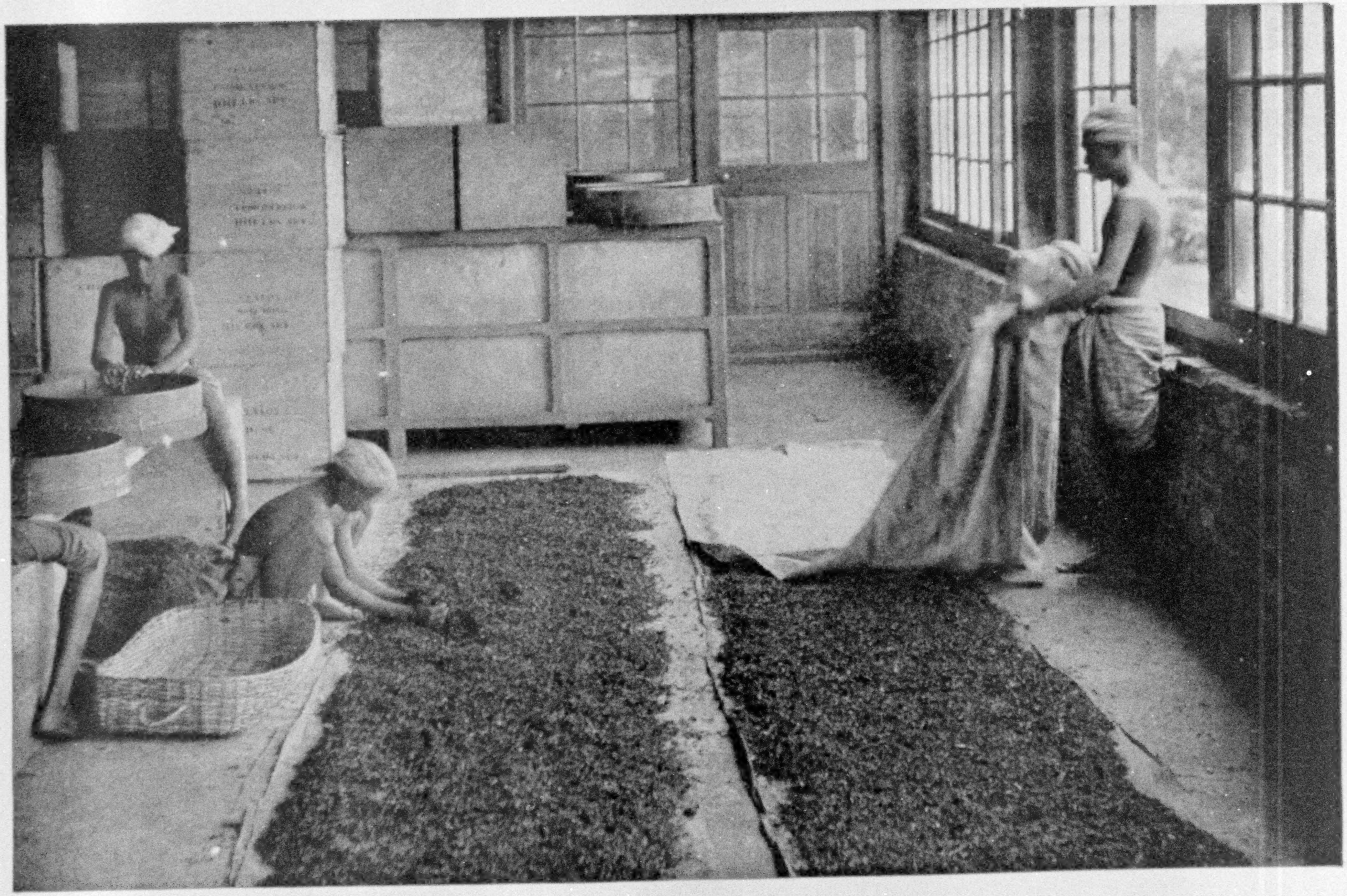


PAYING OFF THE PICKERS: CEYLON

"The average pay of 10 and 16 United States cents a day on the tea plantations is three times as much as they can earn in India; and, in addition, they are housed, given medical care, and schools provided for their children" (see page 147)



FERMENTING THE TEA

After the leaves are brought to the factory they are spread out on trays or racks for about 24 hours and allowed to wither. The leaves are then "rolled" (see page 169) in order to crush the leaves so as to liberate the juices. The leaves are then spread out in a cool house, as shown in this illustration, and allowed to ferment for several hours to make the "black" tea of commerce. If "green" tea is desired the leaves are not fermented. "Green" tea and "black" tea may come from the same tree; the difference is due entirely to the manner of treatment after picking.

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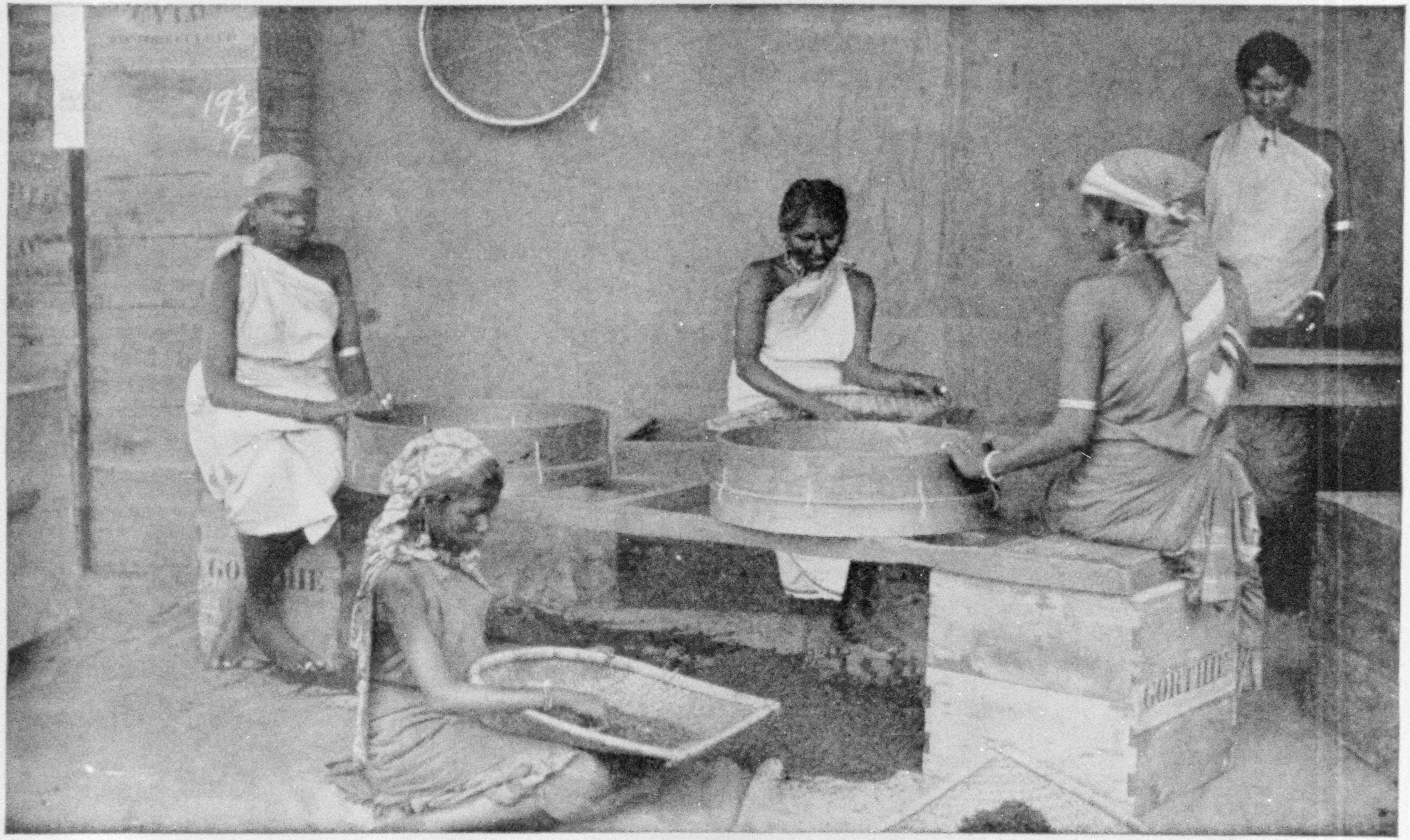
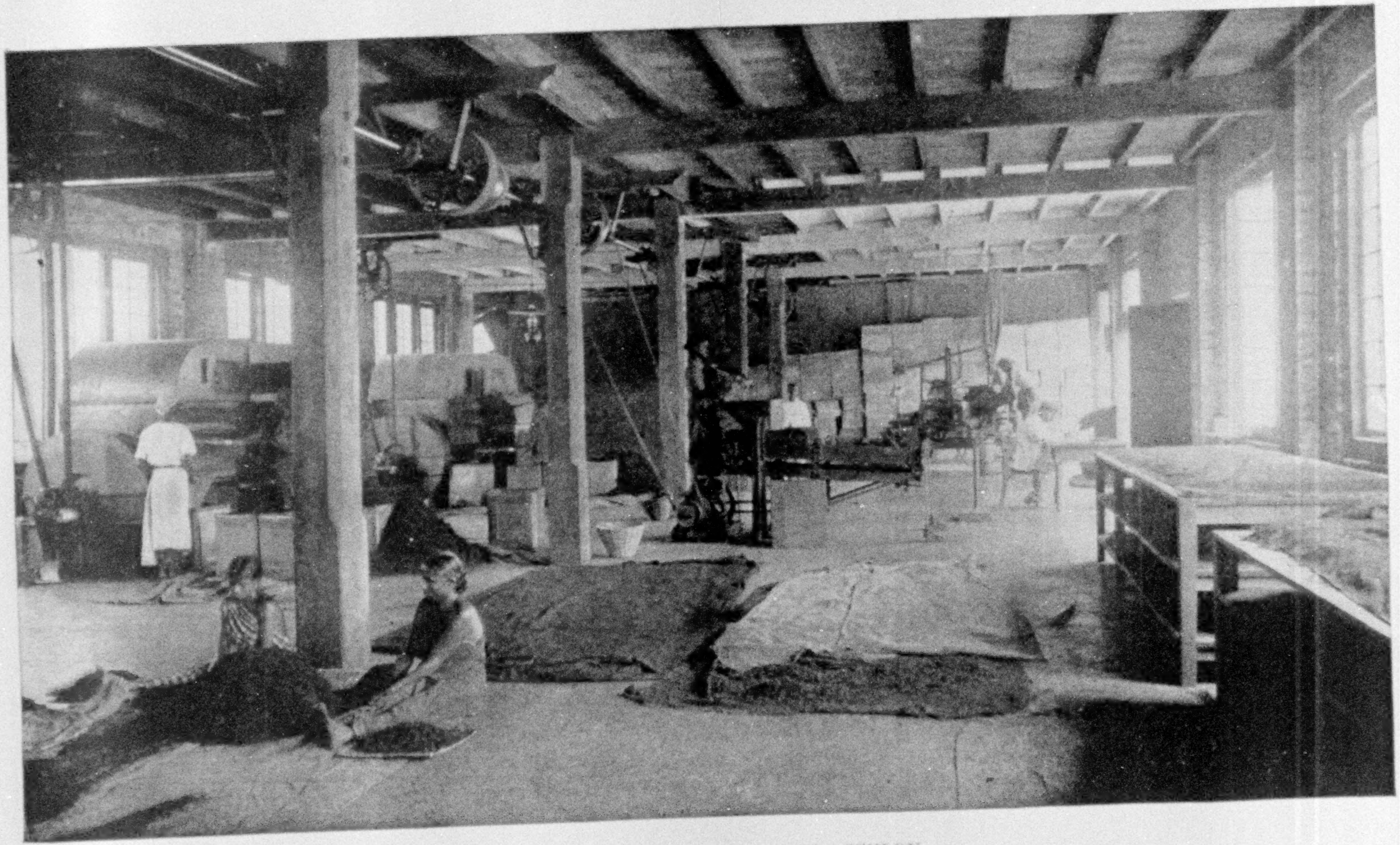


PREPARING THE TEA BEFORE PACKING

After the leaves have fermented for several hours they are dried by hot air and then sifted into the various grades or qualities in which they are packed



SCENE IN A LARGE TEA-HOUSE: CEYLON

Most of the processes involved in tea culture may be seen in this room: on the right are the trays where the tea leaves are withered; on the left, big rollers in which the leaves are slightly crushed; on the floor the tea leaves may be seen fermenting, and in the background is the sifting and packing department. Some of the large tea estates have arrangements by which the tea is not handled after it has been picked.

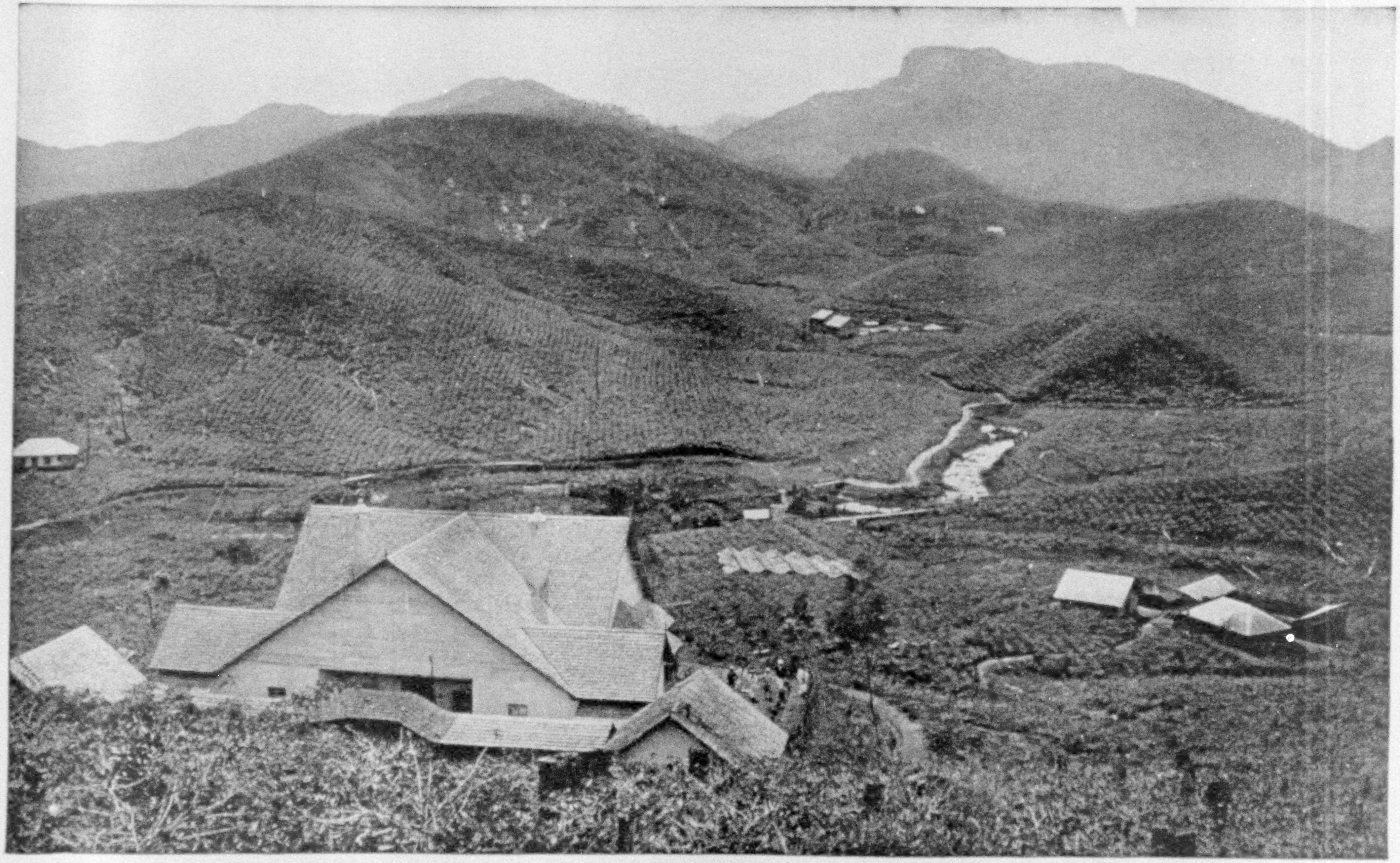


Photo from Eliza R. Scidmore

A LARGE TEA PLANTATION IN CEYLON

The British are the greatest tea drinkers their average consumption being 6.17 pounds of tea for each person every year. Canada, Australia, and the people of New Zealand come next. A pound of tea is consumed by each person in Russia every year, while the per capita consumption in the United States is .89 pound. The French and Germans drink very little tea, the annual quantity used by each person in France and Germany being only .06 and .11 pound respectively. Most of the tea used in America comes from India and Ceylon, these countries exporting 240 million and 170 million pounds respectively. China exports about 188 million, Japan 39 million, and Formosa 20 million pounds per year.

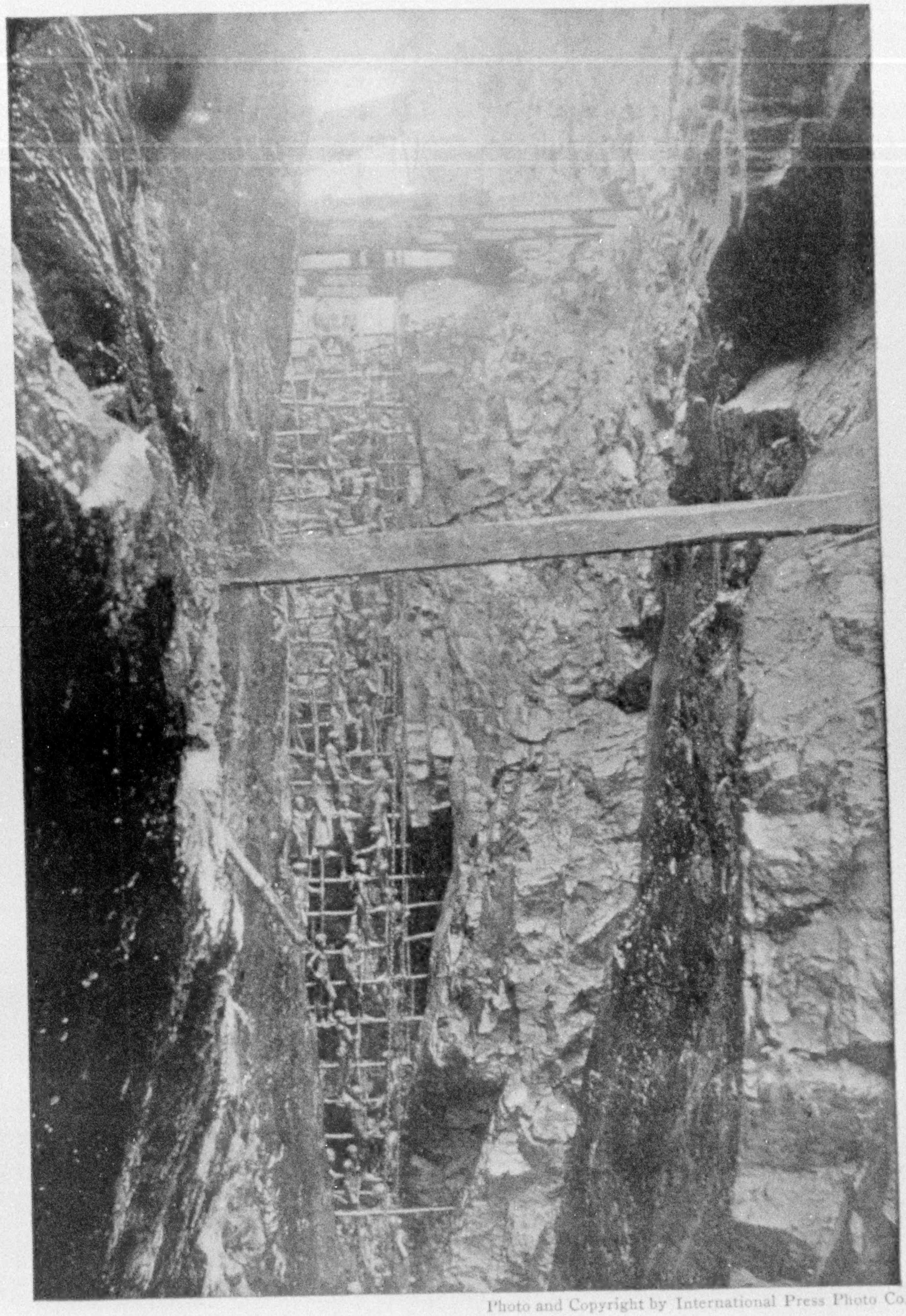


Photo and Copyright by International Press Photo Co.

BAMBOO LADDERWAY IN GRAPHITE PIT: A CONTINUOUS STREAM OF MINERS CARRYING BASKETS OF PLUMBAGO: CEYLON

Graphite, which is one of the softest minerals, is found in veins several feet in thickness, sometimes possessing a columnar structure, perpendicular to the enclosing walls. Chemically graphite is identical with the diamond, but between the two there are wide differences in physical characters. Graphite is black and opaque, and the diamond, the hardest mineral known, is colorless and transparent.

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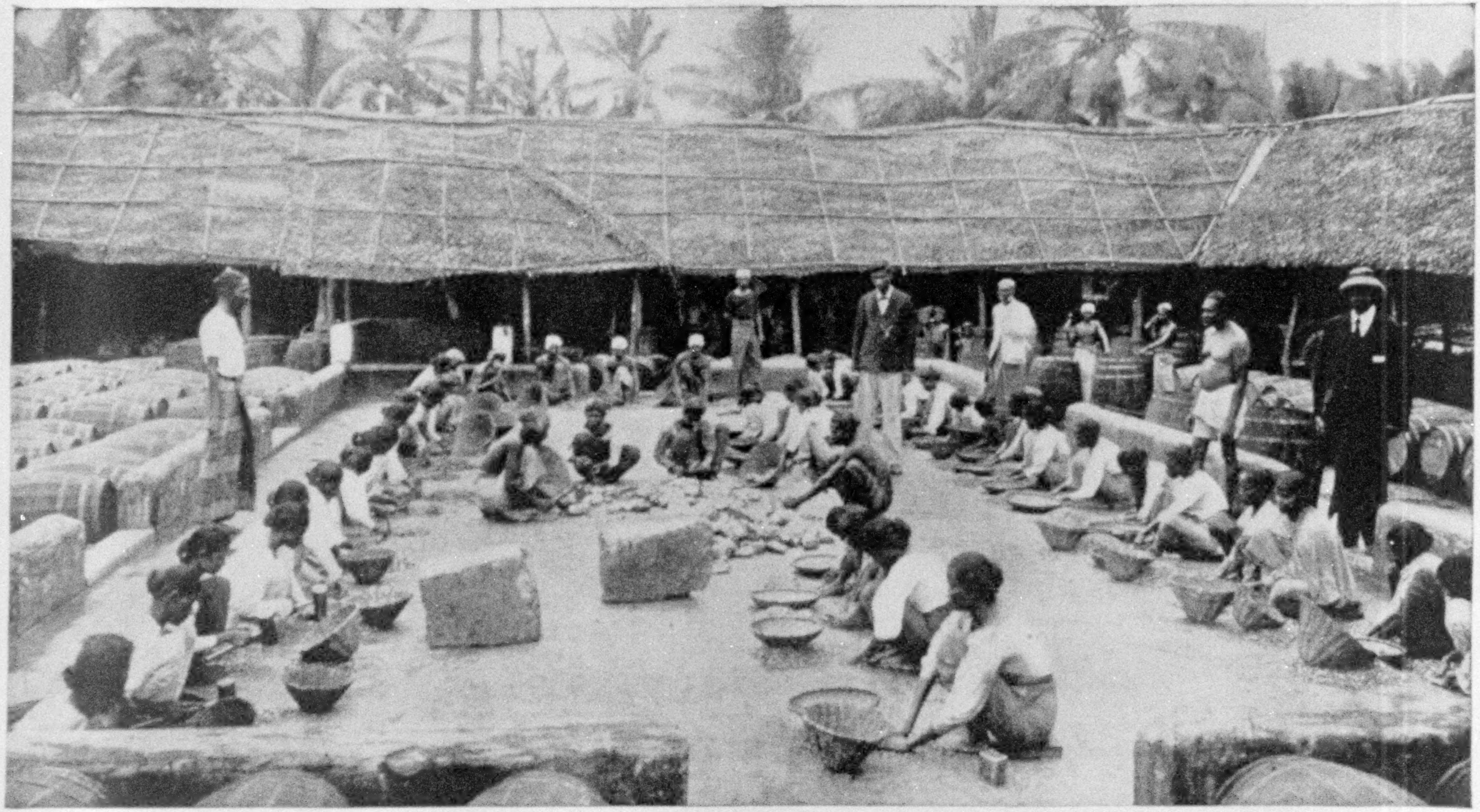

Photo and Copyright by International Press Photo Co.

WOMEN HAND-CLEANING, SIFTING, AND BREAKING LARGE PIECES OF GRAPHITE AFTER SCREENING: CEYLON

The name graphite, from the Greek word meaning "to write," was originally given the mineral because it is used to such a large extent to make pencils. Many mines, in Ceylon and elsewhere, supply large quantities, but it is also produced artificially to a great extent. After being mined the ore has to be crushed and the graphite floated off in the water. In addition to pencils graphite is used in the manufacture of dry lubricants, grate polish, paints, crucibles, and for foundry facings.

mainland is a much smaller and simpler project than that of the one across the Florida keys, and it is inconceivable how it can be much longer delayed. Patronage is waiting, since 100,000 people in a season visit the great Dravidian temple of Rameswaram on Paumben, a shrine of the most elaborate kind, on the most stupendous scale—gateways a hundred feet high, corridors with carved columns and painted ceilings a thousand feet long, and other details in proportion.

THE PEARL FISHERIES OF CEYLON

By Hugh M. Smith

United States Deputy Commissioner of Fisheries

As soon as a traveler sets foot on the shores of Ceylon he comes under the subtle charm of the land, and is quickly imbued with the feeling that it would be most incongruous if such a climate did not produce the most luxuriant foliage, the most beautiful flowers, the most luscious fruits; if such a soil did not give forth the most wonderful profusion and variety of precious stones; if such surrounding waters did not yield the most resplendent pearls.

Ceylon has long been celebrated for its sapphires, rubies, cat's-eyes, moonstones, opals, amethysts, carbuncles, and emeralds; but none of these, nor all of them combined, have given to the island the fame and the romantic setting that have been conferred on it by the product of the limpid waters that bathe its coral strands and sandy beaches. The poetic name of Ceylon today is "The Pearl on India's Brow."

Colombo, the principal city of modern Ceylon, is a stopping place for all the steamers plying between Europe and Asia and Australia, and is therefore visited by thousands of tourists and travelers each year. But the pearl fishery is so remote from Colombo that not one visitor in ten thousand ever goes there.

In Colombo a person sees only a fraction of the great pearl crop, of which more than 90 per cent—99 per cent in some years—goes to India; but this fraction is sufficiently seductive to the transient visitor to render uncertain the time and manner of his arrival home, for the pearl shops in Colombo are veritable magnets that irresistibly attract the contents of purse and wallet.

FISHERIES 2,500 YEARS OLD

The pearl fishery of Ceylon and of India and the Persian Gulf is of very great antiquity, and is thought to be the oldest established fishery now in existence. The Sinhalese records, going back to about 550 B. C., indicate that the fisheries were then well developed, and there is reason to believe that they flourished at least 500 years before. At a very early period the pearls brought the island into prominence abroad, and were in great repute in Rome at the time of Pliny, who, referring to Ceylon under the name of Taprobane, wrote that it was "the most productive of pearls of all parts of the world."

From the most remote period of which there is any record, it would appear that the pearl fishery played a very important part in the history of Ceylon, having had more or less direct and intimate relations with every important aspect of the civilization of the island. The information available clearly suggests that from the earliest times the fishery was conducted in much the same way as in our own day—the same methods of obtaining the pearl oysters, of handling the catch on shore, and of extracting the pearls.

In the words of a local writer, "Ceylon is a place with a glorious past. Its once magnificent cities are now but a mass of crumbled and half-buried ruins; its native dynasty has passed away forever;

XUM

one institution alone has descended to us unchanged by the vicissitudes of 3,000 years—the pearl fishery."

In medieval times there was a very considerable literature of the Ceylon pearls and pearl fishery. In addition to frequent references in Arabic and Persian records of the eighth to eleventh centuries, the accounts of various European travelers (one of whom was Marco Polo, 1291) have come down to us and given glimpses that show how similar were the conditions then and now. The modern history of the pearl fishery, especially under British rule, has been most elaborately recorded.

THE PEARL OYSTER

It is hardly necessary to state that the pearl oyster of Ceylon, like the pearl oysters of other lands, is not an oyster at all. It is more nearly related to the mussels than to the oysters, and it differs markedly from the latter in having a byssus, or a bundle of tough fibers, by which it attaches itself to the bottom.

There are pearl oysters and pearl oysters. There are the huge thick-shelled species of the South Seas, Australia, Philippines, and Burma, that are as large as dinner plates and weigh 3 to 4 pounds as they come from the water; there are the small, thin-shelled forms of Venezuela, Japan, Persia, and Ceylon, that are only a few inches in diameter and weigh only a few ounces.

The large pearl oysters produce the mother-of-pearl of commerce, which is so valuable that the fishery is profitable even when no pearls are obtained. The smaller mollusks have little value except for the pearls they yield.

The maximum size attained by the Ceylon pearl oyster is only 4 inches, and the shells are so thin that they may be crushed between the fingers of an average man.

THE PEARL-OYSTER GROUNDS

Pearl oysters are found on all parts of the coast of Ceylon, but exist in sufficient abundance to support an important fishery only in the Gulf of Manaar, which is a large indentation between Ceylon and India, lying immediately south of the line of giant stepping-stones known as Adam's Bridge.

The pearl oysters are more or less concentrated on banks, which occupy a shallow, level plateau, extending from the shore for a distance of 3 miles in the southern section to 20 miles in the northern and broadest part of the gulf. This plateau is bounded by the 10 or 12 fathom curve, and falls away quite abruptly, so that within a very short distance of the fishing grounds we may get soundings of 100 fathoms, or even 1,000 fathoms. The area of the pearling grounds is about 800 square miles. The bottom is for the most part sand, diversified by outcroppings of calcareous rocks, which form flat or slightly inclined ledges, on which the pearl oysters grow. Aggregations of ledges constitute "paars," or banks, which centuries ago received names that are still applied.

The largest and most important of these grounds is Cheval Paar, lying from 9 to 13 miles offshore at a depth of 5 to 8½ fathoms, and extending about 6½ miles from north to south and 4½ miles from east to west.

UNCERTAINTY OF THE PEARL-OYSTER SUPPLY

Probably the most remarkable feature of the Ceylon pearl fisheries is the extreme uncertainty of the supply of pearl-bearing oysters, so that from early times, and doubtless from the very beginning, the fisheries have been most unreliable and intermittent. A Dutch official, writing in 1697, remarked that "the pearl fishery is an extraordinary source of revenue on which no reliance can be placed," and a British official in 1900 said: "This statement holds good after a lapse of more than two centuries. Indeed, the periodical disappearance of oysters from certain of the banks, sometimes for many years at a time, may be said to form one of the peculiar characteristics of the Ceylon fishery."

It is a matter of record that during the 19th century there were only 36 years when fishing was possible. Mentioning only the longer periods of cessation, it may be noted that there were no fisheries in the years 1821 to 1828, in 1838 to

1854, in 1864 to 1873, and in 1892 to 1900.

It was this last long series of recurring failures that induced the Ceylon government to secure the services of an eminent English biologist for a comprehensive investigation of the pearl-oyster grounds and of the causes for the disastrous failures. The result was that a great deal was made known concerning the conditions of life of the pearl oyster, and for the first time information was afforded the government by which the industry might be placed on a stable basis. Forthwith, in spite of a vigorous protest, the government leased the pearl fishery to a private syndicate and retired from the business from which it had been obtaining a large but not steady income.

WONDERFUL PRODUCTIVENESS OF THE PEARL OYSTER

As we study the life of the Ceylon pearl oyster, two points of transcendent importance are disclosed: (1) The mollusk is prolific to an incalculable degree, and (2) it is subject to an overwhelming mortality, which at times completely nullifies its productiveness.

The numbers of oysters produced are absolutely beyond comprehension. A few years ago, on one paar five miles long and two miles wide, small pearl oysters were ascertained to be present to the number of 10,000 per square yard, in places forming a layer over the bottom nine inches deep; one diver, who was down only 30 seconds, brought up 3,225 young oysters by actual count. This condition of the grounds was determined in November by government inspectors; in December of the same year no oysters whatever were found—all had disappeared as if by magic. On another bank, known as the Periya Paar, scientific experts in the year 1902 estimated the number of young oysters at one hundred thousand million, but so insecure was their existence that on inspection a few months later it was found that all had been swept away.

This destruction is due to a variety of causes, but principally to two: physical agencies, such as the burying of the oysters by sand, which are ordinarily responsible for only 4 to 5 per cent of the mortality; and animals, particularly fishes, of which various kinds and sizes feed largely on the pearl oysters, and are so charged with fully 90 per cent of all the losses to which the young and full-grown mollusks are subject.

Trigger-fishes, sting-rays, and other species with powerful jaws and strong digestive powers frequent the pearling grounds in hordes and find the pearl oysters entirely to their liking. Suggestions for protecting the grounds from the ravages of fishes have been made at different times. No practicable remedy has been offered, however; and, even if there were, there might be a potent reason for not applying it in the fact that this destruction of oysters by fishes is a step—and an essential one—in the formation of pearls.

ADMINISTRATION OF THE PEARL FISHERIES

Up to a few years ago, and for more than a century before, the British officials in Ceylon had absolute control of the fishery, and determined when a fishery should occur and what grounds should be opened to the divers. This determination was based on an examination of the various grounds in the November preceding a fishery, and a preparatory inspection of the particular grounds selected in the following February.

The preliminary inspection of the oyster beds on which it is proposed to permit the divers to work is for the purpose (1) of ascertaining the approximate number of pearl oysters that may be taken, (2) of marking the areas on which fishing is to be allowed, (3) of specifying the number of boats on each area and the number of days that are to be devoted to the fishery, and (4) of making an official valuation of the prospective pearls in order that the fishery may be advertised.

The official examination of the oyster grounds immediately before a fishery is one of the most interesting features of this great industry. The inspector anchors his boat in the center of what is regarded as a typical area, and is attended by four smaller boats each containing three divers. These boats are

XUM

rowed in concentric circles about the central vessel, and at intervals the divers are sent down with instructions to bring up every mature oyster they can collect in each dive. This work continues until 12 circles—the outer 1½ miles in diameter—have been run about the anchored boat and about 325 sample lots of oysters brought up.

The area covered by oysters being computed in square yards, the approximate number of oysters thereon is estimated by taking the average number of oysters per dive in conjunction with the average amount of bottom a diver is adjudged to clear at one descent (2½ to 3 square yards). The government estimates based on this method are sometimes remarkably close. Thus, in 1904, the prospective yield of the fishery was announced as 35 million oysters, and as a matter of fact 37 million were gathered.

In conjunction with the determination of the approximate number of fishable oysters on the beds, 25,000 to 30,000 oysters from various grounds are opened and their pearls extracted, sorted, and appraised under government auspices, the valuation being entrusted to disinterested pearl merchants. A rough basis is thus afforded for estimating the average worth of the pearl oysters per 1,000, and this information is published broadcast by the government in the circular announcing the fishery.

The pearl content of the oysters varies from year to year and on different parts of the same ground, owing to several factors; and the advance estimate of the government has the praiseworthy object, if it does not have the effect, of keeping the speculative fever within reasonable limits. It has sometimes happened that notwithstanding the formal assurance of the government that the grounds to be opened for fishing will probably yield pearls of the value of, say, 20 rupees per 1,000 oysters, the pearl merchants have run the prices up to 40, 60, 80, or more rupees.

MARICHCHUKADDI, THE PEARL TOWN

News that a fishery is to be held travels as by wireless telegraphy throughout Ceylon, India, and other parts of the East, and at the prescribed time 30,000 to 50,000 people gather in a few days on a strip of desert sand, with the Persian Gulf on one side and the jungle on the other, at a point convenient to the pearl-oyster grounds. A town covering a square mile springs up like a boom town in the West, with regular streets, private houses, shops, markets, banks, a cemetery, and government buildings, such as a court-house, post and telegraph offices, prison, and hospital. In the outskirts of the town large water-tanks are constructed to supply water for washing clothes and for bathing; there are also wells or cisterns throughout the town. As there is no harbor, the fishing boats draw up in a long line on the beach.

A more heterogeneous aggregation of humanity could hardly be found elsewhere. Besides the British officials, with their assistants and servants and the force of 200 native police, there are the multitudes of fishermen, merchants, mechanics, pawnbrokers, money-lenders, priests, coolies, and pearl buyers and speculators, of every conceivable color, speaking a score of tongues, and representing half a dozen religions. To amuse, divert, and prey on those who have legitimate business in the pearl town, there are fakirs, jugglers, dancers, beggars, gamblers, and loose characters of both sexes, providing every allurement that will appeal to the sons of Buddha, Brahma, and Mohammed.

The chief of police wrote of the pearl town in 1905: "There were 40,000 to 50,000 persons, of whom it may be said that not less than a tenth were gamblers, vagrants, and rogues, who, without occupation in their own country, made their way to Marichchukaddi with the hope of making money to gamble in oysters."

Here we may study under very favorable conditions the distinctive personal habits and customs of nearly every littoral race from the Yellow Sea to the Mediterranean. Here are thousands of the most attractive members of the Ceylon population—the Sinhalese or Ceylonese proper—varying in color from light to dark bronze, with their slender, graceful forms and finely cut features; here are the black Tamils, most unat-

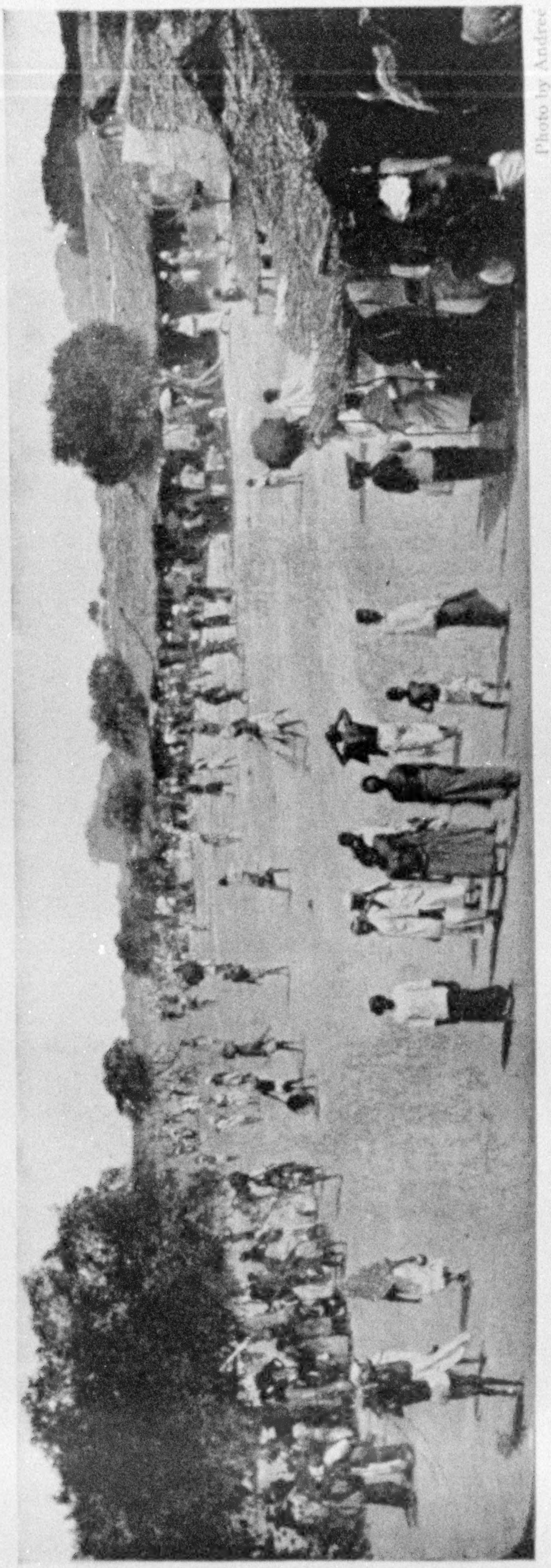

Photo by Andree

MAIN STREET IN MARICHCHUKADDI, THE PEARL TOWN OF 50,000 PEOPLE, WHICH SPRINGS UP IN A FEW DAYS (SEE P. 176)

tractive and unfortunate victims of their religion and caste; here are Kandyans from the hill country and outcast Veddahs; here are native-born Dutch, Portuguese, and half-breeds, all mingling with Arabs, Chinese, and the scum and riff-raff of the mainland of Asia.

It can readily be understood that the pearl town is a place of intense activity from the moment the government agent opens the fishery. The extensive business connected with the mere existence of the people would alone be sufficient to give great bustle and life; but added to this are the special industries dependent on the various phases of the pearl fishery.

As soon as the fishery is over, the entire place seems to dissolve in a day as if by magic, the people hurry to their homes, the pearl town lapses again into a solitary sandy waste, and the beasts of the jungle take possession. Marichchukaddi may spring into being the next season, but may remain non-existent for many years.

THE DIVERS, THEIR BOATS AND METHODS

Four distinct racial types are represented among the divers who are attracted to the pearl town when a fishery is announced, and all of these and several others congregate on shore to supply the needs of the vessel crews. There are Tamils, most of whom come from the coast of the Madras presidency; Moormen, who are chiefly drafted from villages on the Madura coast of the same state; Malays from the southern part of the Malabar coast, and Arabs, mostly recruited from Colombo and Jaffna. The Tamils and the Moormen are the most numerous, usually representing about four-fifths of the total number; the Arabs are the least numerous, but are the most proficient as fishermen.

There is no particular style of

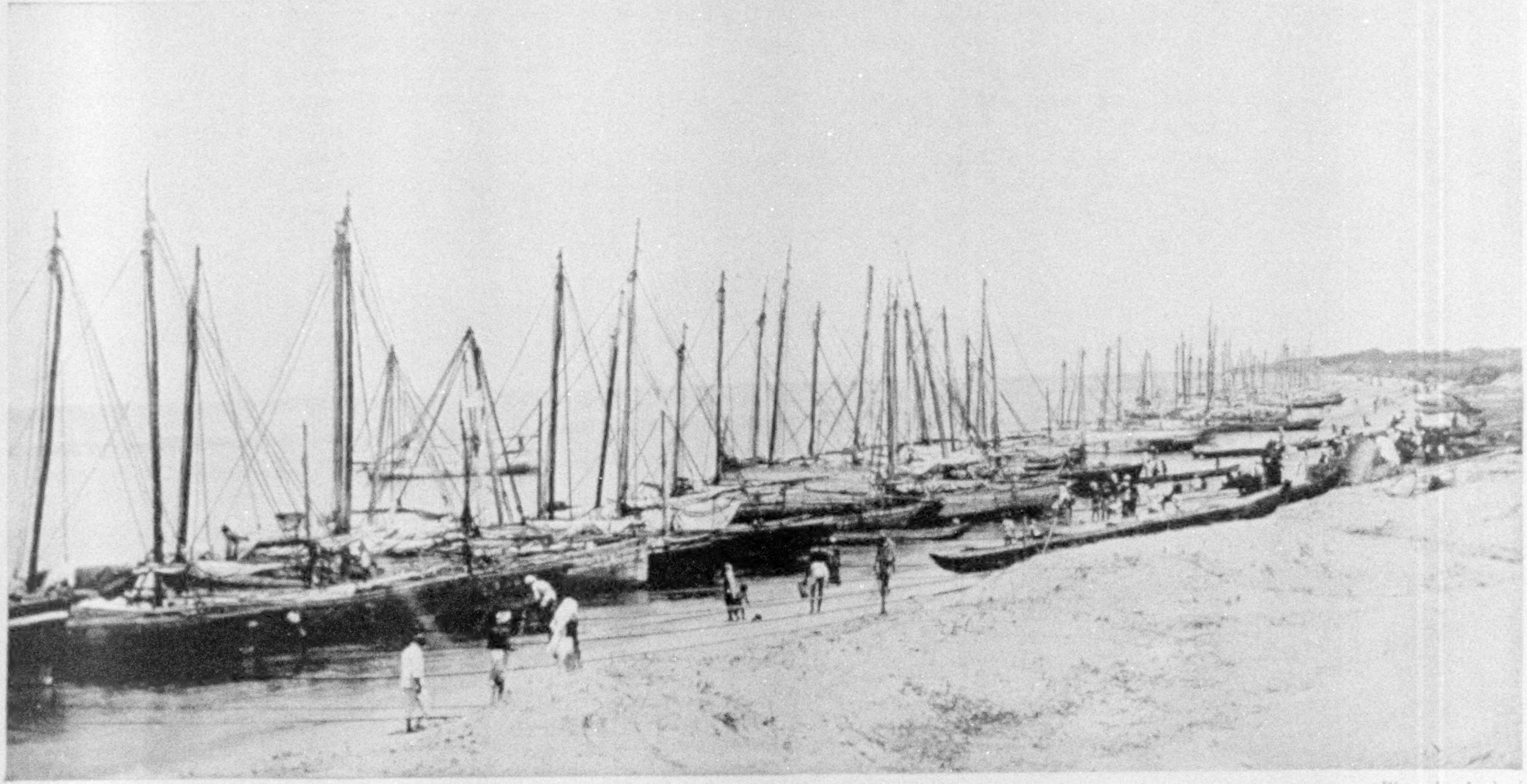

Photo by Andreé

THE PEARL FLEET PREPARING TO START FOR THE PEARL GROUNDS

"There is no particular style of vessel specially required in the pearl fishery, and consequently we find a great diversity of rigs, depending largely on the regions from which the divers come: narrow single-masted canoes with an outrigger, square-sterned luggers, large sailing lighters, three-masted canoes, and clumsy doneys. Some of the larger vessels carry 65 men, of whom about half are actual divers, and the average crew of the entire fleet is 30 to 35 men" (see pages 177 and 179).

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Owing to the boisterous seas and strong winds of this region, the fishery can be conducted only during a period of a few weeks in March and April, when the northeast monsoon has waned and the southwest monsoon has not begun. The fishery is thus of briefer duration than any other pearl fishery of importance, and is characterized by a strenuousness that is quite foreign to the East.

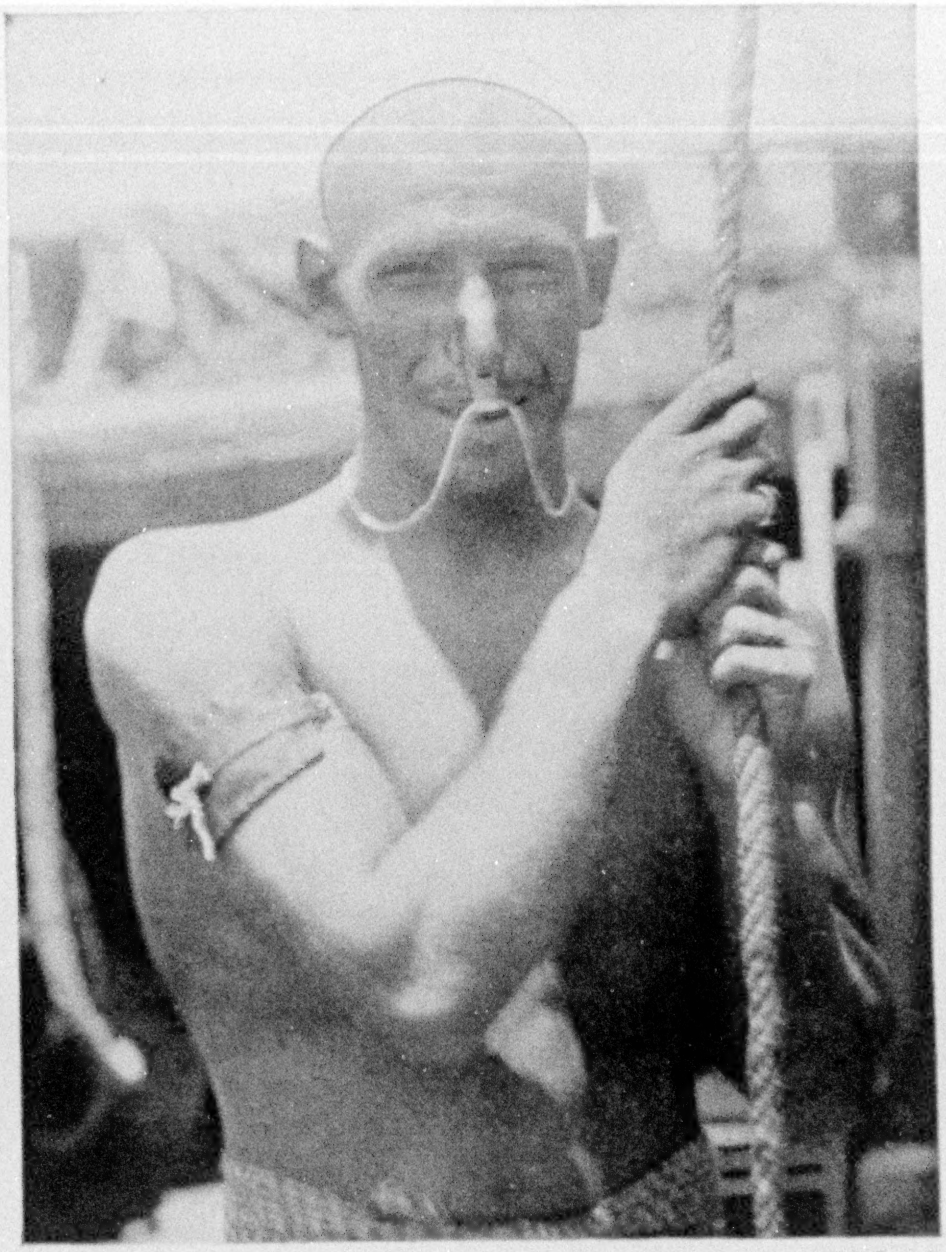

Photo from Dr. Hugh M. Smith

AN ARAB DIVER FROM THE PERSIAN GULF, WITH NOSE-CLIP

"A great deal of sentiment has been expended on the pearl-divers and the dangers they have to undergo, particularly from rapacious man-eating sharks. The writers of both poetry and fiction for centuries have played on the feelings of humanity in depicting the perilous life of the divers. As a matter of fact, there is no particular risk or hardship encountered by the Ceylon divers. Year after year, among the 3,000 to 9,000 divers engaged, not a single fatal or serious accident may occur" (see page 183).

The fishing boats start for the grounds soon after midnight, so as to be ready for work as soon as daylight comes, about 6 a.m. They take positions about the government vessel moored over the particular ground selected, anchor, and remain actively engaged until noon, when the entire fleet sets sail and starts for the shore. As there is a crowd of pearl merchants eagerly awaiting an opportunity to speculate, there is considerable rivalry among the diving boats in the matter of reaching land and discharging their catch as soon as possible, and consequently one witnesses some wild scenes of excitement when the oysters are being unloaded in the surf and the natives are rushing into the kottus with their catch.

Except for a loin cloth, the divers are naked. Their fingers are covered by flexible leather shields to protect them from the rough corals and shells. In order to facilitate the descent, each diver employs a flat, oval stone, weighing 30 to 50 pounds. The stone is perforated at one end to receive a rope, and close to the stone a kind of stirrup is made in the

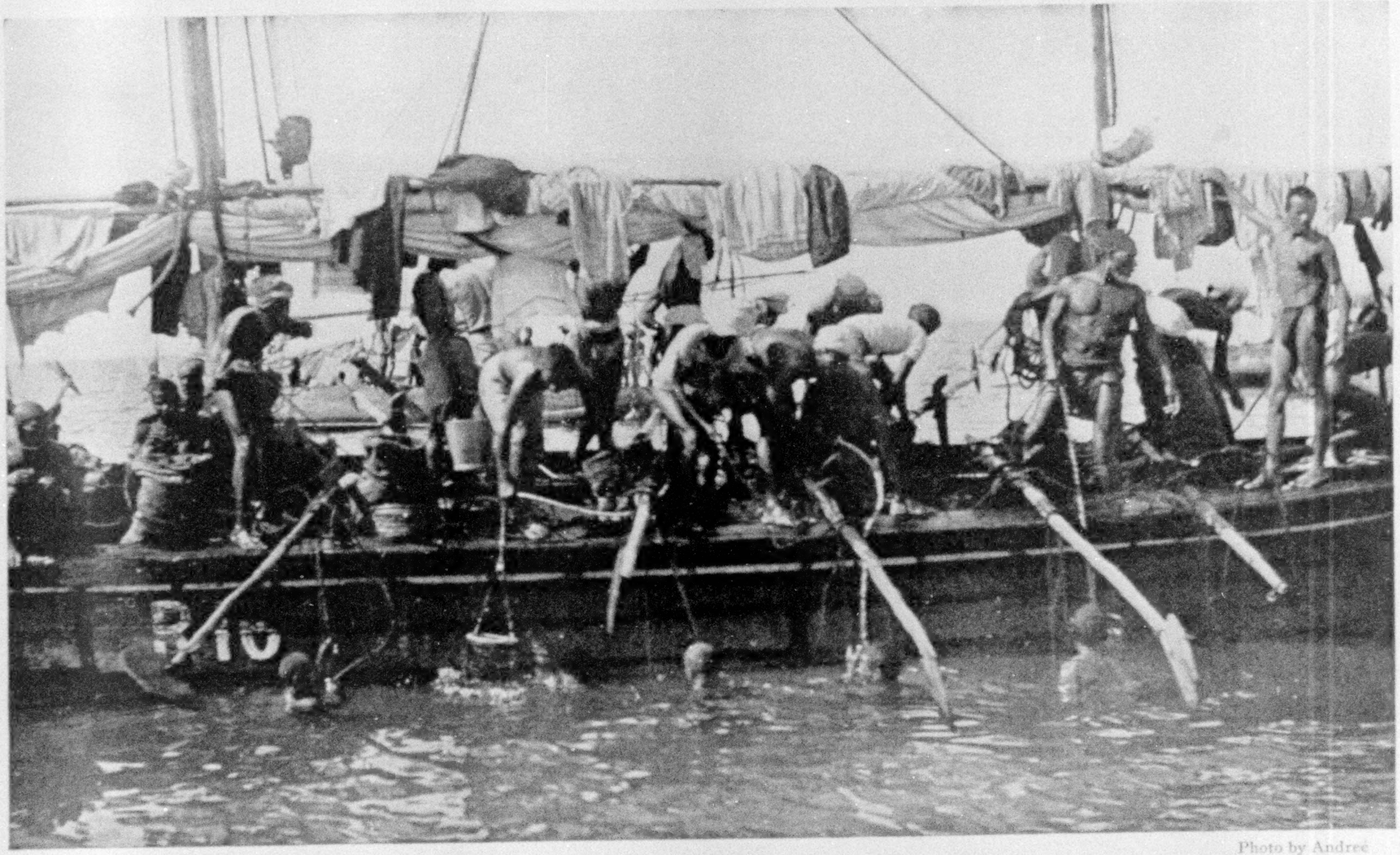

Photo by Andrée

ARAB PEARL-DIVERS AT WORK: EACH DIVER HAS A "MANDUCK," OR HELPER, TO WATCH AND HELP HIM IN AND OUT OF THE WATER (SEE PAGE 182)

"The descents occur at intervals of 5 or 6 minutes. The best divers are careful to dry their bodies thoroughly after each descent and to take sufficient rest. Between dives they often smoke a pipe or cigarette, sometimes while in the water just preparatory to a dive."

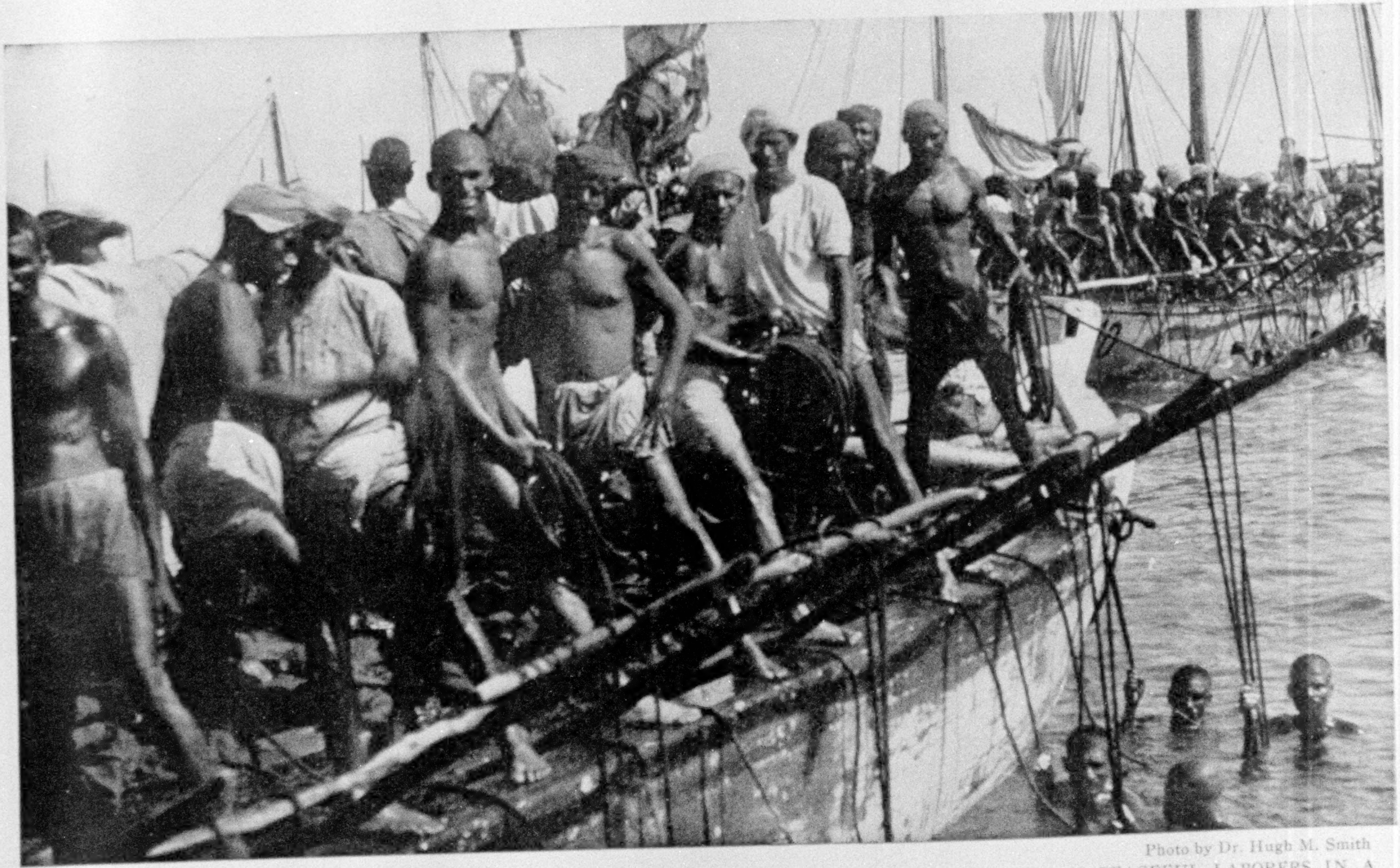

Photo by Dr. Hugh M. Smith

THE PEARLERS LOOK MORE LIKE PIRATICAL CREWS ABOUT TO BOARD A CAPTURED PRIZE THAN PEACEFUL LABORERS IN A WATERY VINEYARD

"On what is regarded as good ground, the average per man per dive is 25 to 35 oysters, but it sometimes rises to 75 or drops to 5 or nothing at the end of a fishery. On one day in 1904 twelve boats, manned exclusively by Arabs, fishing from dawn till noon had an average catch per boat of 22,811 oysters" (see page 182).

rope to accommodate the diver's foot. The stone is suspended at a depth of 4 to 5 feet below the surface by means of a cord attached to an outrigger.

When ready to descend, the diver places one foot on the stone, the other on the rim of a rope basket attached to a rope, inflates his lungs, loosens the slipknot holding the stone, and sinks rapidly to the bottom. There he at once disengages his foot and quickly crawls over the bottom, tearing loose all the oysters he can reach and putting them in the basket. When near the limit of his endurance, he gives a signal with the basket rope and is quickly hauled up by the watchful attendant, or "manduck," with whom the diver is provided. The helper has meanwhile pulled up and secured the diving stone, and when the basket is hauled in he culls the catch from the miscellaneous refuse that is attached to the oysters.

HOW LONG CAN A DIVER REMAIN UNDER WATER?

The divers usually operate in pairs, with a common attendant and diving stone. The descents occur at intervals of 5 or 6 minutes. The best divers are careful to dry their bodies thoroughly after each descent and to take sufficient rest. Between dives they often smoke a pipe or cigarette, sometimes while in the water just preparatory to a dive.

The divers have learned by experience that they may increase the length of their submergence by making a number of deep, forced respiratory efforts before taking the plunge. Most exaggerated stories have been told and are still current regarding the length of time the divers can remain under water.

The Arab divers wear nose-clasps of flexible horn attached to a cord around their neck, while the divers of other races simply compress their nostrils by hand during the descent. This practice can hardly make any difference in efficiency, and we must conclude that the expertness of the Arabs depends on an aptitude born of long experience.

Their usual time below the surface is 60 to 75 seconds, the normal maximum not exceeding 90 seconds, while the Tamil and Moormen divers range from 35 to 50 or 60 seconds, depending on the depth. There is a well authenticated case in 1887 of an Arab who remained under for 109 seconds in water 7 fathoms deep.

The most curious feature of many of the ancient and some of the modern accounts of the pearl fishery is the remarkable ability to remain under water ascribed to the Arabs and others, and it is noteworthy that this ability increases with the remoteness of the time. Percival, whose "Account of the Island of Ceylon" was published in London in 1803, said the usual time for the divers to remain submerged "does not much exceed two minutes, yet there are instances known of divers who could remain four or even five minutes. . . . The longest instance ever known was of a diver who came from Anjango in 1797, and who absolutely remained under water full six minutes."

Le Beck, in his "Asiatic Researches," London, 1798, reports that he saw a diver remain down for seven minutes. Sir Philiberto Vernatti reported to the Royal Society of London in 1667, in response to a special inquiry of the society, that "the greatest length of time that pearl-divers in these parts [Ceylon] can continue under water is about a quarter of an hour."

The Dutch anatomist Diemerbroeck, in his "Anatomy of the Human Body" (1672), cites the case of a diver who, under his own observation, used to work under water for half an hour at a time; and Batuta, another man of science, writing of pearl-divers in 1336, said that "some remain down an hour, others two hours, others less."

The number of oysters taken at each dive necessarily varies greatly, depending on the diver, the depth, and the density of the growth. On what is regarded as good ground, the average per man per dive is 25 to 35; but it sometimes rises to 75 or drops to 5 or nothing at the end of a fishery. On one day in 1904 twelve boats manned exclusively by Arabs fishing from dawn till noon had an average catch per boat of 22,811 oysters. Usually the men do not like to work on grounds that yield less than 15

Photo by Andree

THE FIRST TO LEAVE THE BANKS AFTER THE MORNING'S DIVE

or 20 oysters per dive, so the grounds are rarely stripped clean, so far as human agency goes.

A great deal of sentiment has been expended on the pearl-divers and the dangers they have to undergo, particularly from rapacious man-eating sharks. The writers of both poetry and fiction for centuries have played on the feelings of humanity in depicting the perilous life of the divers. As a matter of fact, there is no particular risk or hardship encountered by the Ceylon divers.

Year after year, among the 3,000 to 9,000 divers engaged, not a single fatal or serious accident may occur. An Englishman, who spent a number of years on the fishing grounds during the entire season, never had a glimpse of a single shark dangerous to man. An English official, who had a life-long experience in the Ceylon pearl fisheries, never knew of a single diver being killed by a shark, and heard of only one case and that extremely doubtful. Still another Englishman, writing in 1887, stated that it was "pretty certain that in the whole course of the Ceylon fisheries only two human beings have fallen victims to these fierce fishes" (see also page 190).

ILLICIT TAKING OF PEARLS

On the trip from the fishing grounds to the shore the divers and manducks have two to four hours of undisturbed leisure, in which they improve the opportunity to open oysters and extract and conceal any pearls they may find. This practice

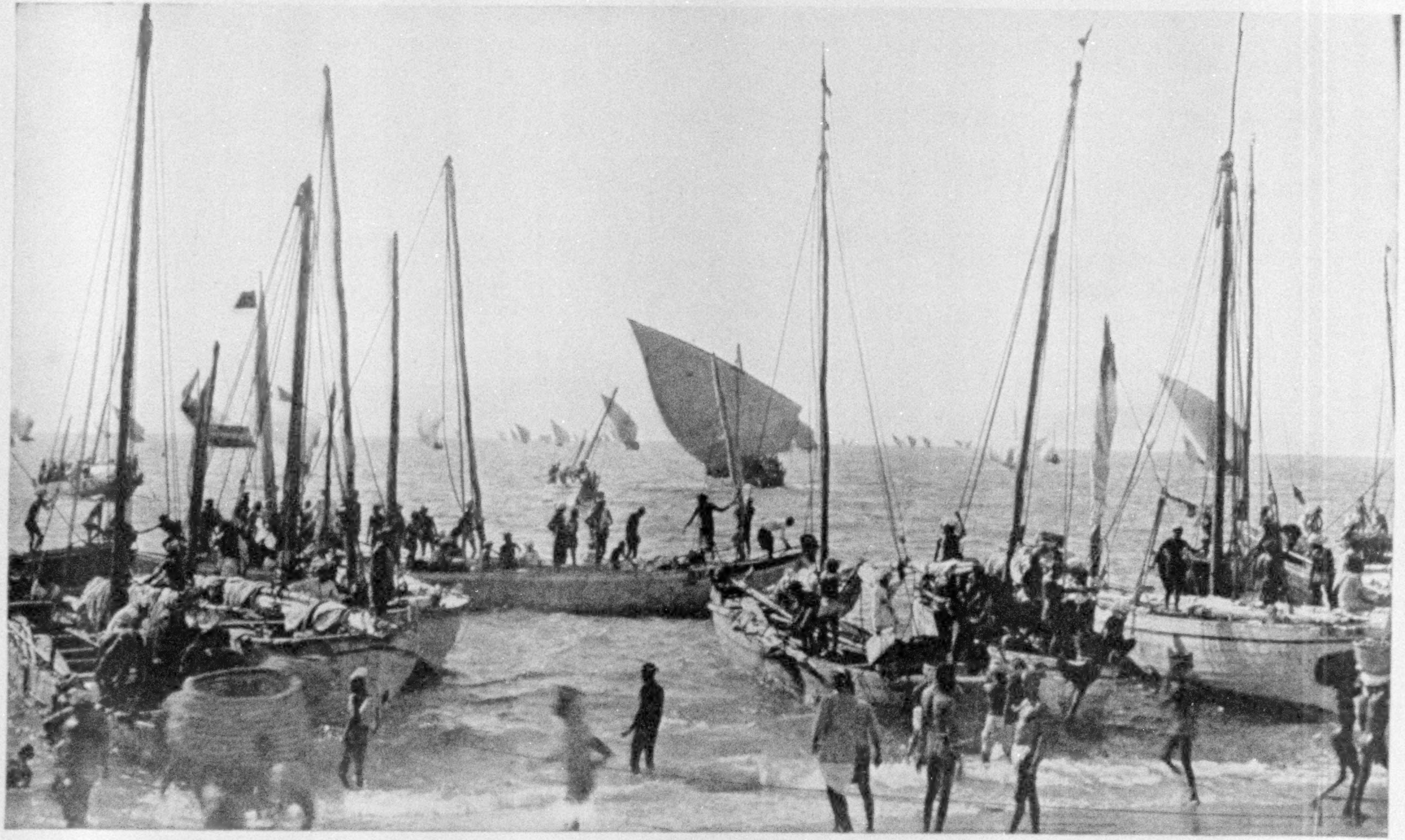

Photo by Andreé

THE FLEET RETURNING FROM THE PEARLING GROUNDS

"On the trip from the fishing grounds to the shore the divers and manducks have two to four hours of undisturbed leisure, in which they improve the opportunity to open oysters and extract and conceal any pearls they may find. This practice is illicit and in violation of the fishery regulations, but it is very difficult to suppress. Guards have sometimes been employed on each vessel, but as they are the friends of the divers and receive only 33 cents a day for their services, there is every reason to believe that they require no large inducement not only to countenance, but actually to encourage, this fraudulent work."

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The government estimates that at times fully 25 per cent of the catch is illicitly opened; and, as the largest and most productive oysters are thus weeded out, the government losses in revenue have been considerable. It was computed that in 1905 not less than 15 million oysters were opened by the divers on the homeward trips. These, at the average selling price for the season, were worth $250,000 regardless of the contained pearls. The men resort to all kinds of expedients for concealing the pearls in order to avoid detection by the shore officials before whom they have to pass.

DIVISION OF THE SPOILS

Under the arrangement that has prevailed for many years, the divers are allowed to retain one-third of their catch, to dispose of as they please. The government retains the remainder and sells it at auction.

The most important structures in the pearl town are the palisaded enclosures, known as the kottus, in which all of the pearl oysters are deposited and retained until disposed of. The fences are made of bamboo poles, and within the enclosures are bamboo sheds with thatched roofs of palm leaves.

When the boats reach shore the oysters are quickly unloaded and taken at once to the near-by government kottus, where the catch of each boat is put in a separate compartment. The divers count their catch into three piles containing the same number of oysters, and the government agent then selects the pile that shall go to the crew.

The divers then emerge from the other (land) side of the kottus carrying their precious oysters, and are at once surrounded by a crowd of natives desirous of obtaining oysters in small quantities. The trade conducted by the divers is of a strictly retail nature, and it sometimes happens that a native—man, woman, or child—will buy on speculation a dozen or half a dozen oysters, or even a single one. The stock of the divers is usually eagerly sought and quickly bought.

After disposing of their catch the divers spend the remainder of the day in eating, resting, bathing, and religious devotions.

The government's share is carefully counted by clerks, and about sunset each day is put up and sold at auction at the court-house by the government agent. The unit of measure is a thousand, and a successful bidder may take one or many thousand at the price offered. During the night the oysters are carefully guarded, and next morning the buyers present their certificates of purchase, pay the price, and take their goods.

ROTTING THE OYSTERS

It is a very difficult matter to extract the pearls from perfectly fresh oysters either by sight or by touch, or by both combined; consequently it has long been the practice to allow the decomposition of the soft parts before the search for the pearls is begun. The rotting process is exceedingly repulsive, and if the wearers of beautiful pearl jewelry realized the unspeakably filthy mass from which their gems had come, some of the more esthetic would shudder every time they beheld them.

The oysters are piled into dugout canoes and covered with matting or else set aside in coarse sacks for 7 to 10 days. Bacterial putrefaction is supplemented by the work of blow-flies and their larvæ, and at the end of the period stated the disintegration, decomposition, and digestion of the oysters have progressed so far that there is little left but pearls, shells, slime, and foreign matter adhering to the shells, together with a large volume of maggots. The first step in the cleansing process is the flooding of the canoe to the brim; then the naked natives, ranged on either side of the vessel, remove the shells, washing and rinsing them and removing any detritus in which a pearl may lodge.

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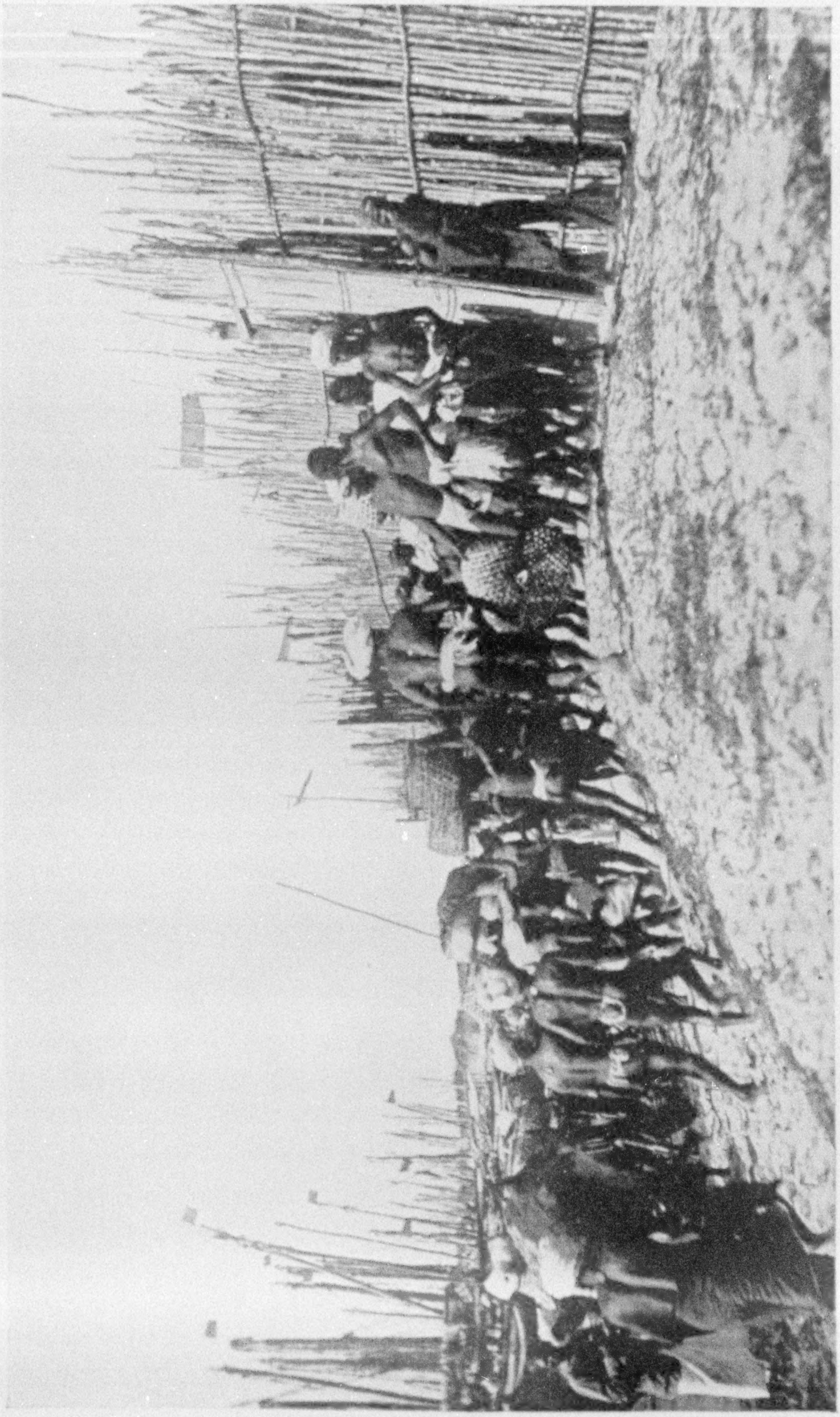

Photo by Andrée

THE PEARL OYSTERS BEING CARRIED FROM THE BOATS INTO THE GOVERNMENT KOTTUS TO BE COUNTED AND APPORTIONED (SEE PAGE 185)

Eternal vigilance must be exercised by the owners to prevent the theft of pearls, and one of the precautions taken is to forbid the washers to remove their hands from the water except to drop at their feet the cleansed shells.

The shells having been removed, the canoe is filled with water again and again, and the gurry is kneaded and stirred in order that the lighter filth may be floated off. The water is finally decanted, and the heavier débris containing the pearls is removed with scrupulous care and wrapped in cotton cloth, undergoing a preliminary search for the largest pearls and numerous subsequent examinations in the course of drying.

The dried matter is then sifted and sorted and gone over again and again; and then, when it would appear that even the dust pearls must all have been extracted, the débris passes for a final search into the hands of women and children, whose sharp eyes and delicate touch enable them to discover an amazingly large quantity of small pearls. The material then remaining is offered for sale and always finds ready buyers.

We can easily imagine the anxiety of the speculators, especially the small plungers, when the washing of their pearl oysters has begun, and we can readily understand the nervous tension under which they exercise the right to thrust their hands into the gurry and pick out the pearls. Having the scantiest clothing, or none at all, whenever they withdraw pearls from the mass of putrid matter and squirming maggots they may deposit them in the safest and most available receptacle—their mouth!

THE GREATEST FISHERY ON RECORD

The most productive fishery in the recorded history of Ceylon was held in 1905. Three hundred and eighteen vessels participated, and during the season that extended from February 20 to April 21 over 81,000,000 pearl oysters were landed, whereas the best previous fishery, in 1891, yielded only 44,000,000. On a number of days over 4,000,000 oysters were obtained, and one day, when 5,005,000 were taken, a record was established that may never again be equalled.

The preliminary government inspection of the oysters on the grounds set apart for the fishery showed pearls present of the average value of about 23 rupees ($7.70) per thousand; but at the beginning of the fishery there was a marked enhancement in the value of pearls in the world's great markets, and the value increased during the progress of the fishery, so that the speculative prices for the oysters at times soared to $30 and even $40 per thousand, and the average price for the season was $16 to $17, making the first yield of the fishery about $1,365,000, excluding the value of oysters stolen by the natives while on the boats. The prices of pearls in Bombay and Paris warranted the prices paid in Ceylon for the oysters, and the merchants who sold their holdings made large profits.

RECENT HISTORY OF THE FISHERY

The continuation of the high prices for pearls and the large profits of the 1905 fishery resulted in unusual interest in the season of 1906; the 473 vessels that reported for employment carried 8,600 divers, of whom about 4,100 were Arabs, a much larger number of this race than had participated in this industry in recent times. There was a large catch, and the oysters were purchased at abnormal rates. In the subsequent year also prices ranged high.

In 1906 a record was established, when on one day 309 rupees (over $100) per 1,000 oysters were paid, and in 1907, when the speculation fever attained unusual severity, 70 to 90 rupees were not infrequently bid for oysters that ordinarily would bring only 15 rupees, and the verdict for the season was that the contained pearls did not warrant the prices paid. Then came the financial panic. The demand for pearls in Paris, London, and New York fell off, prices dropped, and the Bombay merchants lost heavily, and several of the leaders committed suicide in consequence.

It is a rather interesting fact that since the government leased the pearling rights to a private syndicate in 1906 there has been no fishery worth mentioning. Notwithstanding this, however,

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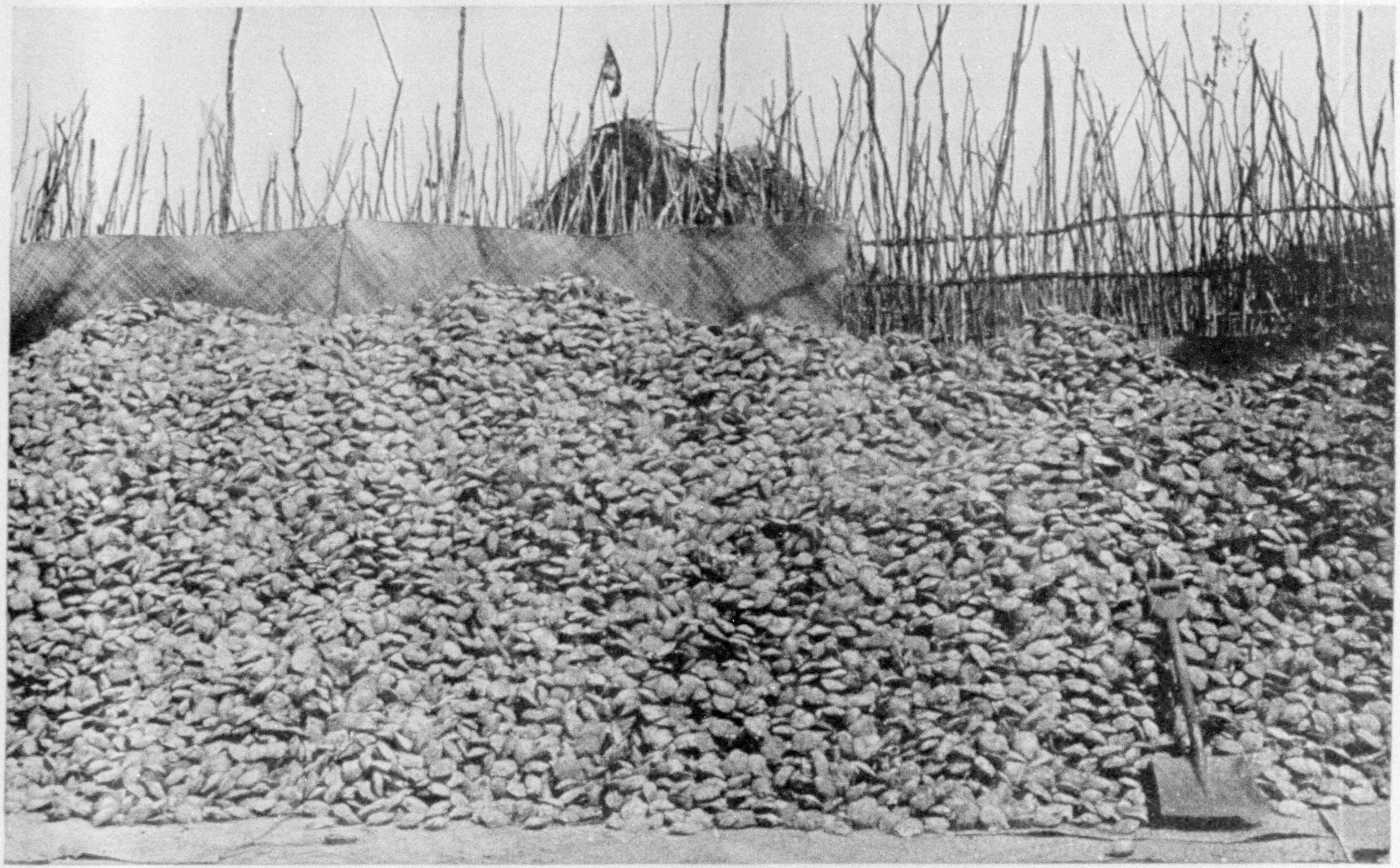

Photo by Andreé

THE BEST PART OF A MILLION PEARL OYSTERS

The stench from these rotting oysters is appalling, and few Europeans can stand it. The natives, however, seem to mind it not at all

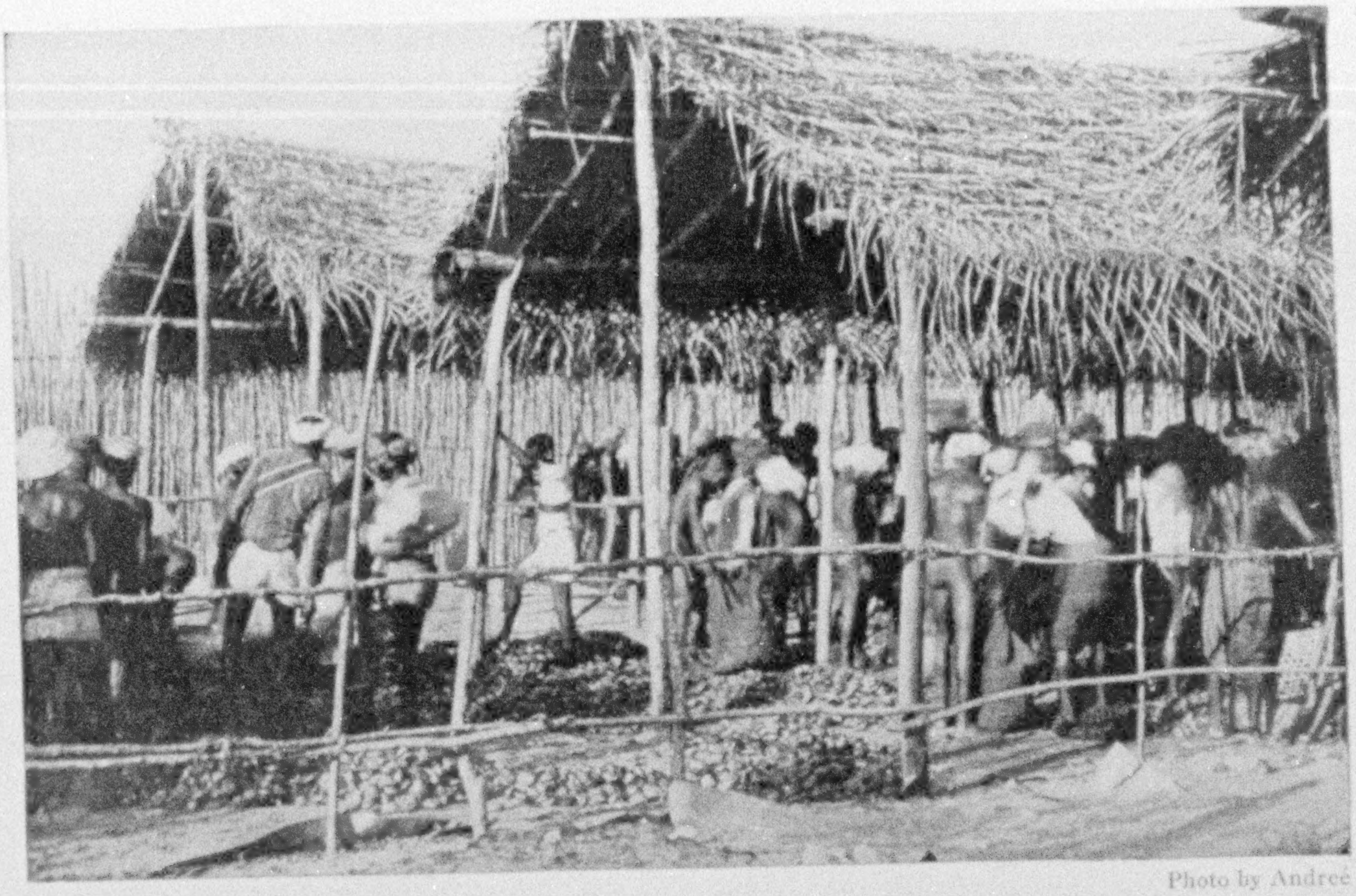

Photo by Andrée

THE DIVERS RECEIVING THEIR WAGES IN OYSTERS: THEY FREQUENTLY FIND VERY VALUABLE PEARLS IN THEIR SHARE AND ARE MADE RICH FOR LIFE

the company, having received the government's proceeds of the fishery during the last year under the old régime, has been able to declare large dividends, and the stockholders have had reason to be well satisfied and can afford to wait awhile for another successful fishery.

Recent reports received from Ceylon were quite alarming as to the condition of the grounds. No spat had fallen; there were few adult and young oysters on the grounds, and no fishery was expected for several years.

THE FAKIRS

The pearl fishery is the Mecca of all sorts and conditions of fakirs from all over the East. There are snake-charmers, conjurers, astrologers, devil-dancers, and all the other oriental counterparts of the fakirs who frequent the county fairs in America, and there are fakirs directly connected with the pearl fishery.

The pearl fakirs sit about the streets at little three-legged wooden worktables, and there drill pearls for stringing; buy and sell defective pearls; convert bad pearls into good ones, and palm off repaired, plugged, peeled, and doctored pearls on the unsuspecting and unsophisticated. Their principal livelihood is from the handling of blemished pearls.

Sometimes pearls will exhibit defects that greatly impair their market value; but there is always a possibility that the blemish may be only "skin deep," and that by peeling off the outer layer or layers of pearly matter the underlying part will be found to be free from defect.

On the other hand, pearls may have superficial defects that detract from their value, but are not sufficient to prevent sale at good prices and their use for special purposes; and such pearls, if peeled in the hope of entirely eliminating their defects, may be rendered worthless by the rapid increase in the size of the defect as the lower layers are uncovered.

One can readily see the elements of

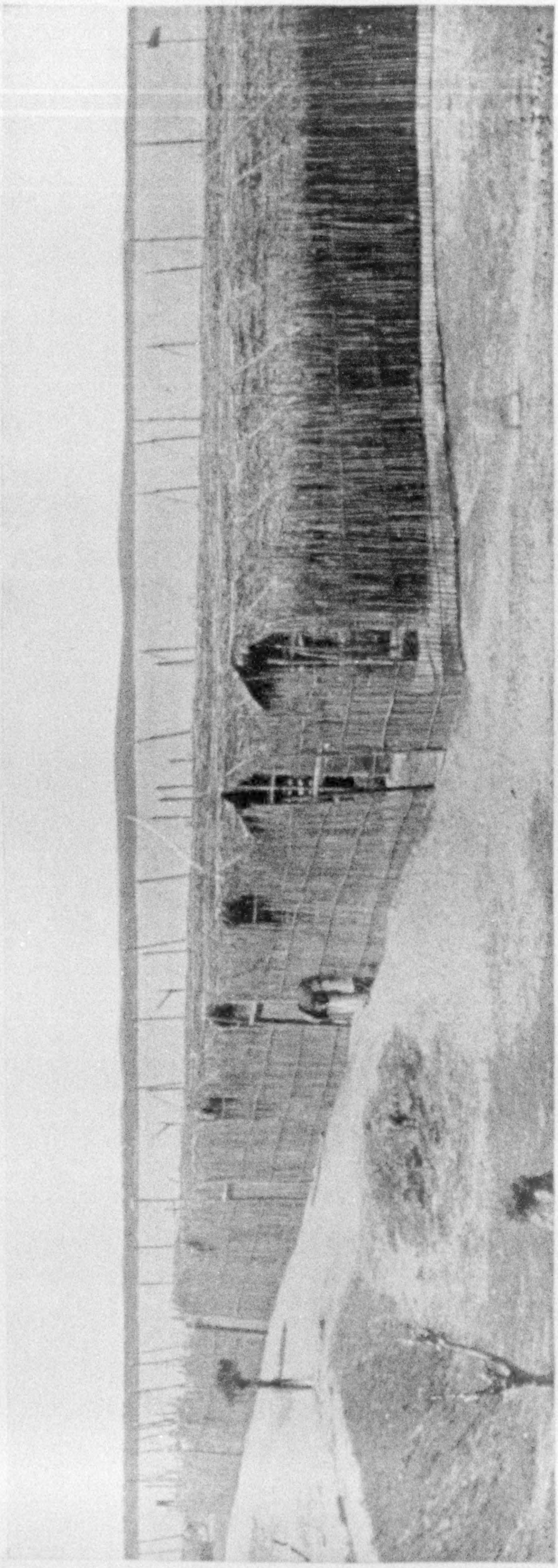

Photo by Andrée

THE GOVERNMENT STOREHOUSES, OR KOTTUS, WHERE THE OYSTERS ARE SAFEGUARDED AND AUCTIONED OFF (PAGE 185)

uncertainty and the lottery possibilities that are here presented to professional fakirs and amateur speculators. To illustrate the uncertainties of pearl faking: I knew of a Tamil laborer who risked his savings of 150 rupees on a blemished pearl, which he forthwith proceeded to peel. The removal of each successive layer left the pearl with a larger visible defect, and when the futility of further peeling was impressed on the speculator he had on his hands a pearl that with difficulty was disposed of at 25 rupees.

A little later this same man, still possessed of the speculative fever, had an opportunity to buy for 75 or 100 rupees a pearl with a large discoloration, which possibly involved only the superficial layers. Not wishing to run the risk alone, he induced two others to enter the pool with him. The pearl, subjected to the skillful treatment of a fakir, was soon rid of its defect and ultimately sold for 900 rupees.

Notwithstanding the comparative safety of the diver's vocation, from a very remote period up to a recent date the ignorant and superstitious Indian divers insisted on the presence at each fishery of shark-charmers, whose function it was, for substantial considerations, to keep the sharks away from the individual divers, and who had the power to make sharks bite divers who did not exhibit a proper respect for the conjurers' powers. These impostors appear to have reached the height of their influence in the 13th century, when there was probably one on each diving boat and when their share amounted to fully five per cent of the aggregate take of oysters. Under the Portuguese it was deemed expedient to permit 12 of these fakirs to ply their trade, with diminished privileges and

Photo by Andreé

PEARL BUYERS: THESE MEN OF MANY RACES AND CREEDS ARE WONDERFULLY EXPERT IN RECOGNIZING AND APPRAISING PEARLS

income, and when the British acquired Ceylon the number was reduced to two, who at first were allowed to receive one oyster a day from each diver, but later were paid a regular salary by the British government and were forbidden to exact any tribute from the natives. Finally, after flourishing for at least 600 years, and possibly for 1,000 or more years, the shark-charmers were abolished just 25 years ago (see page 183).

THE PEARLS OF CEYLON

Pearls have always been regarded as especially appropriate for the ornamentation of royal personages, and the pearls of Ceylon, owing to the extraordinary numbers that have been produced and the active prosecution of the fishery for ages, have probably been more extensively worn by exalted individuals than have the gems of any other region. The pearls of Ceylon are probably found in the official or personal jewels of every female sovereign and in the crowns and regalia of most of the male rulers of today.

The most lavish use of pearls is met with among the Indian rajahs, some of whom, when clad in their full dress, are literally covered with these gems. These pearly possessions often represent the greatest item of wealth of these nabobs, and are usually heirlooms, added to from time to time and rarely disposed of, so that vast accumulations have sometimes occurred.

The pearls of the Ceylon waters are for the most part silvery white in color; sometimes they are yellowish, creamy, or pinkish. For luster, or "orient," they are surpassed by the pearls of no other

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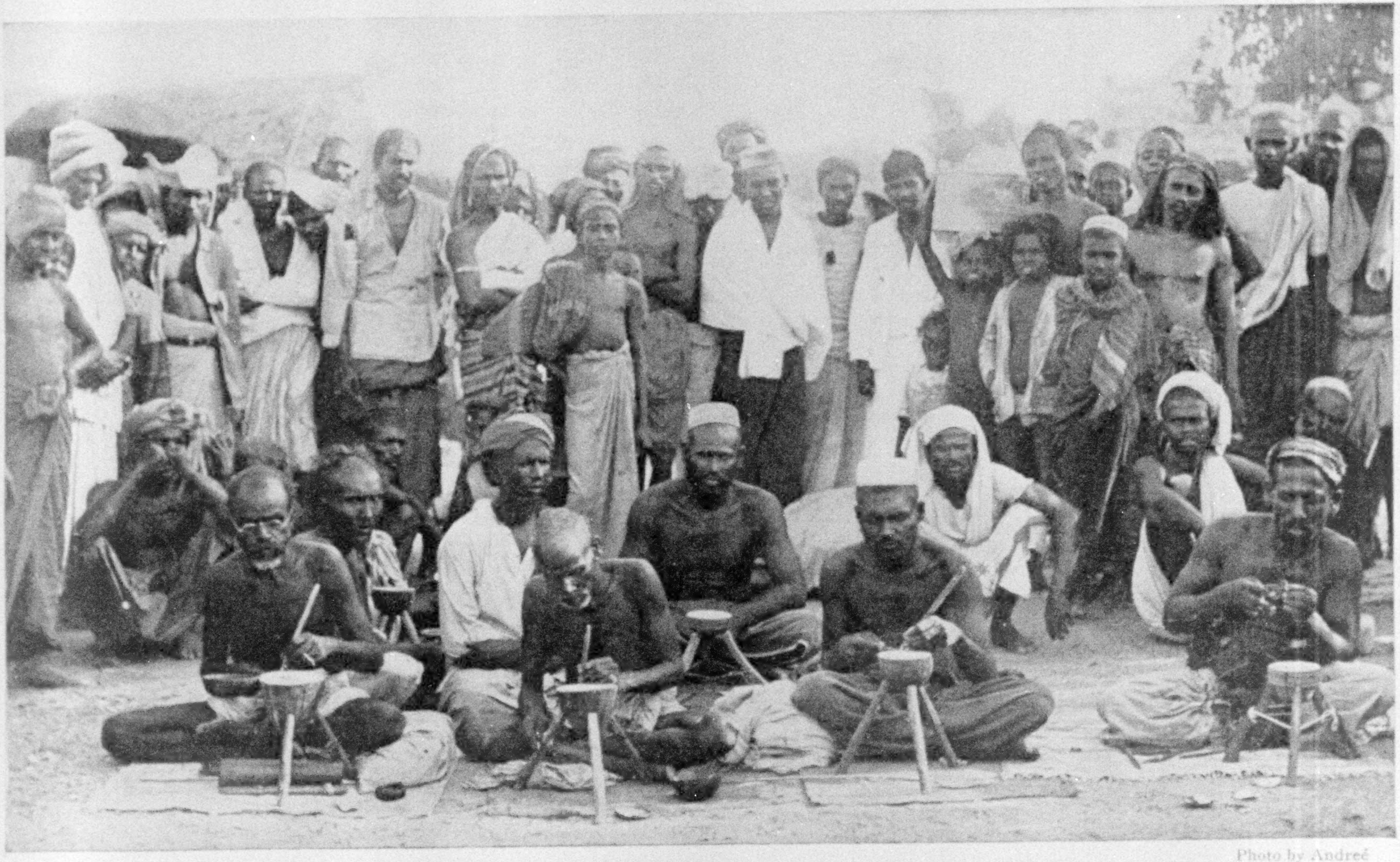


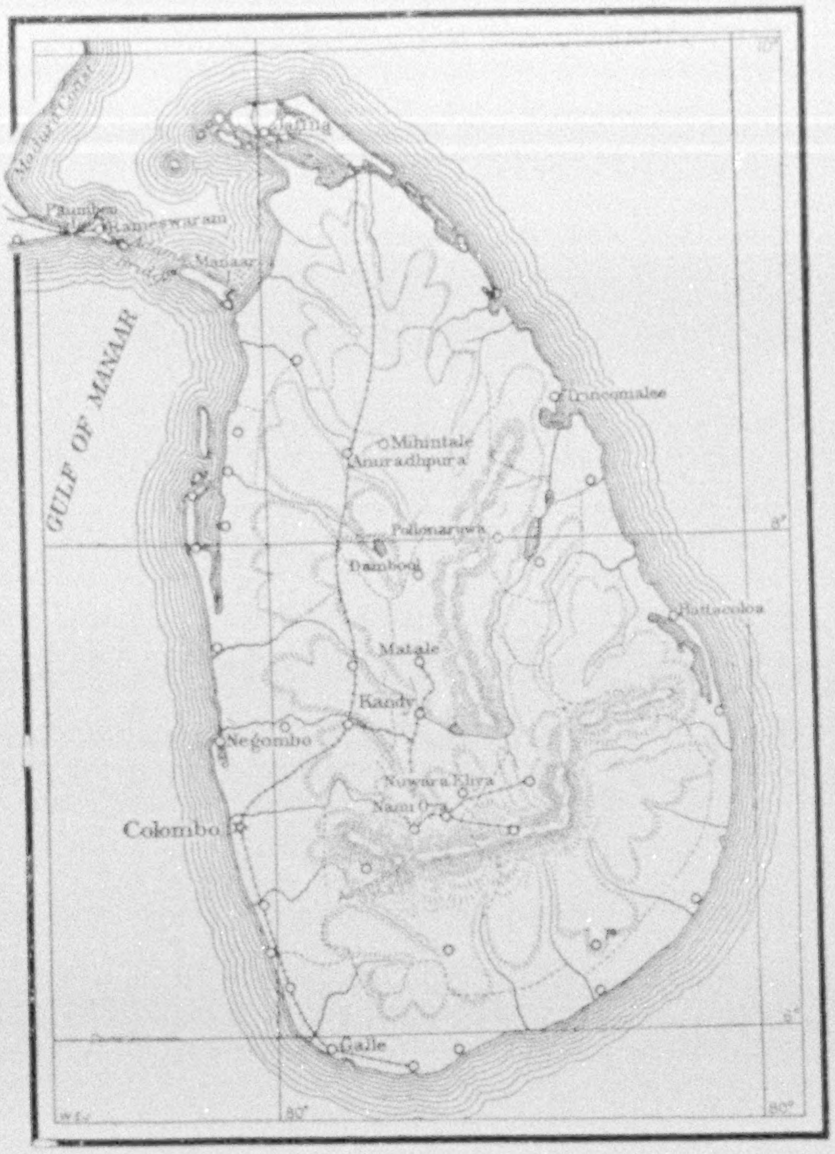
Photo by Andreé

THE PEARL FAKIRS

These men earn a living by stringing, peeling, and repairing defective pearls. They are very skillful workmen, but frequently dishonest in their dealings (see pages 189 and 190) part of the world, and for spherical regularity, also, they are unexcelled. Other peculiarities are that their size averages smaller than elsewhere in the world, and that their number exceeds that in any other fishery. Pearls weighing over 10 grains are very uncommon, and by far the larger number weigh less than two grains. Specimens worth $350 at the fishery are rare; the most valuable pearl found in 1904 sold locally for $830, and the record fishery of 1905 yielded one valued at $4,000.

More seed pearls result from the Ceylon fisheries than from all other parts of the world combined. The most minute, that have no value as pearls, are calcined and sold to the wealthy for chewing with the betel nut. The same use is made of many American fresh-water pearls, for which a market has now been established in Bombay.

Somewhat larger seed pearls, that have no sale outside of Ceylon and India, are placed in the mouths of deceased Hindus of means, replacing the rice grains that are employed for the same purpose by the poorer people.



OUTLINE MAP OF CEYLON (SEE PAGES 115, 135, 145, AND 153)

The larger seed pearls are drilled, strung, and used for ornament. The drilling is done by the most primitive means, and it is a very clever workman who can perforate 40 to 50 pearls in a day with the ancient bow-drill. This will enable us partly to estimate the labor required to drill the 120,000 seed pearls in a necklace, dating from the Louis XVI period, now the property of an American lady. By means of one of the modern mechanical drills, 1,500 pearls may be easily and accurately perforated in a day.

ORIGIN OF PEARLS

Pearls differ from other gems in the brief period of their existence in a natural state, and in the steady renewal of the supply. A diamond or a ruby, formed a hundred thousand or a million years ago, remains practically unchanged until found by man. A pearl, unless plucked when ripe, like a fruit, drops to the bottom and quickly loses its value when the creature that makes and harbors it perishes.

It is interesting to contemplate that in all waters having pearl-bearing mollusks, from the earliest dawn of history down to the present time, much the larger part of the pearl crop has never been harvested and never seen by man, but has been scattered on the floor of the ocean as the oysters have died in the course of nature. This is particularly striking in the case of the pearls of Ceylon because of the brief, almost ephemeral, life of the oysters.

It is not necessary in this article to enter into a discussion of the origin of pearls, but it is not inappropriate that some brief mention thereof be made, because this subject has received special elucidation in Ceylon.

During the first 1,500 years of the present era, and doubtless for many preceding centuries, every theory of pearl formation had as its essential feature the idea that every pearl was originally a drop of dew or rain—possibly a tear—that gained entrance into the shell of an oyster in one of various ways. Pliny the Younger, in his celebrated Natural History, gives a detailed description of this process, and similar accounts appear in the writings of philosophers, travelers, poets, and others in ancient, medieval, and even early modern times.

It is a noteworthy fact that at the present time the Arab, Persian, and Indian divers quite generally believe that at certain seasons the pearl oysters come to the surface in the morning, open their shells, and suck in or imbibe in some way a dewdrop or raindrop, which, suffused with sunlight, is slowly transformed into a lustrous pearl. The American consul at Aden recently reported that the scarcity of pearls in the Red Sea was ascribed by the Arabs to the fact that little rain had fallen for several years.

We now know that almost any kind of foreign body—whether a grain of sand, a bit of mud or shell, a piece of seaweed, or a small animal—may by its irritation cause the mollusk to cover it with nacre and make it the nucleus of a pearl. The pearly matter is slowly deposited in definite layers, and the growth of the pearl continues indefinitely.

But if the annual supply of pearls depended on the foreign bodies accidentally gaining entrance into the cavity of the pearl oyster, there would be no great pearl fisheries, and pearls would not be the highly prized, costly gems they are.

It has now been pretty definitely established that the great bulk of the annual pearl crop of the world—probably 90 per cent of it—represents animal parasites which normally pass a part of their life-cycle within the pearl oysters, and during that period, becoming encapsuled in the tissues of the mollusk, are in time covered with a nacreous coat, owing to the irritation they impart to the oyster. It was not until the middle of the 19th century, however, that the parasitic origin of pearls was proposed and established, and some of the earliest research was addressed to the Ceylon pearl oyster. But it was only during the present century that the true rôle of the parasite and its life history were satisfactorily cleared up.

It is now known that the minute spherical larvæ of various marine worms, but particularly of cestodes, enter the pearl oysters and become more or less embedded in the soft tissues, as many as 40 of these larval worms having been found in one Ceylon pearl oyster. As a result of the irritation caused by a larva, the oyster forms a protecting epithelial sac about the intruder, and then, if the latter dies, its mass is gradually converted into carbonate of lime, pearly nacre is secreted by the contiguous epithelium, and the growth of the pearly mass proceeds with the growth of the shell which is formed in the same way.

Reference has been made to the life-cycle of the parasite. If the larvæ do not die, the hosts may be eaten by fishes and the larvæ will not find lodgment therein and undergo a certain development. Among the fishes that largely prey on the pearl oysters are the tough-skinned, strong-jawed trigger-fishes. These in turn are eaten by large rays that are common on the pearl-oyster grounds, and in the rays the worms reach their full development and produce young (larvæ) that are cast into the water and find lodgment in the oysters.

We are thus prepared to accept the well-known saying of a celebrated French investigator, that "the most beautiful pearl is in reality only the brilliant sarcophagus of a worm."

THE PANAMA CANAL

By William Joseph Showalter

When the British Ambassador, Mr. Bryce, at the recent annual dinner of the National Geographic Society, stated that the American people are carrying to a successful conclusion the greatest engineering achievement of history or of prospect, he spoke in terms of truth and not of poetic license. That it is being carried to a successful conclusion appears when it is related how near to completion the big waterway is; that it will live through all the ages as the greatest single monument to human energy seems evident when the magnitude of the task is put into comprehensible terms.

An excellent idea of the magnitude of the work will appear from a statement of what has been accomplished in the five years of Col. George W. Goethals' directorship of the work, which ends in April. By that time the material removed under his direction will have amounted to the enormous total of 160 million cubic yards. If all this material could be placed in a solid shaft of the shape of the Washington Monument, with a base as large as an average city block, it would tower more than six miles skyward, overtopping the earth's loftiest mountain peak by more than a mile. Again, if it were to be loaded onto the big Lidgerwood dirt cars used on the canal, it would make a string of them reaching over two and a half times around the earth and requiring a string of engines reaching from New York to San Francisco to move them. And yet this will be increased by more than one-fifth before the last carload of spoil is hauled away.

No less impressive is the story of the magnificent manner in which the work is being carried forward. When Congress asked for information as to the number of yards of material to be removed and the length of time it would take to remove it, the engineers, in a report characterized by optimism rather than pessimism, declared there were 103 million cubic yards of material to be removed, and that it would take nine years to do it. Since then enlargements in the bottom width of Culebra Cut, slides, and other conditions have forced the total amount of material to be excavated up to 195 million cubic yards. Under those original estimates it would take 17 years to complete the work. Yet the canal army, under the leadership of Colonel Goethals, will complete it in a little more than six years of actual, full-swing work.

In other words, the amount of material to be removed has been increased by about 90 per cent, while the time of removal has been cut down about 30 per cent.

In 1908 it was estimated that the total amount of material to be removed, as the project was then laid out, would amount to 135 million cubic yards, and that the total cost of the completed canal would be 375 million dollars. Since that time 60 million yards more have been added to the total excavations, and yet the prospect is that enough money will be left on this estimate, as a result of unexampled efficiency and economy, to build a new breakwater and perhaps to make a giant new storage reservoir at Alleluja.

Under what difficulties all of this has been done the world never will fully understand. Think of a farm of 147 acres slipping foot by foot into the canal, and yet being taken out as a mere incident in canal construction! This is the aggregate acreage of the slides that have been slipping in and are being steam-shoveled out. Think of a rainy season where ten feet of water falls in ten months, and still the work goes forward with only slightly slacked speed! Think of having to dispose of nearly two million carloads of spoil annually, much of it upon dirt trains which have to be backed into seas of mud otherwise known as dumps! Then you will begin

XUM

to appreciate what the brave army at Panama is doing.

IN THE HOME STRETCH

In order to appreciate fully how rapidly the canal army is moving down the home stretch in its race against time, let us refer to the map which is published as a supplement to this number and make an imaginary journey across the Isthmus, from Toro Point, Atlantic side, to Naos Island, Pacific side. First we pass the huge two-mile-long Toro Point breakwater, now being built out into the Caribbean to protect the mouth of the canal and Colon harbor from the violent "northers" which sweep down over that region during the winter months. It is now far out into the ocean and will be finished many a month before the opening date. On the east side of the canal line a second breakwater has been laid out, but it will be built only in the event that the Toro Point breakwater is unable to baffle the destructive seas single-handed.

We next enter that part of the canal which is being dug from deep water to Gatun, a distance of seven miles, at sea-level. When completed it will carry the ocean in to Gatun through a channel 41 feet deep and 500 feet wide. Already this channel is navigable to the light-draft vessels of the material-carrying fleet from Gatun, and the first five miles is practically completed. By the end of the calendar year it will be deep enough to accommodate the majority of ships which pass by way of Colon. Six months thereafter it will be completed and ready for even so huge a craft as the Olympic.

We next come to Gatun, where the great dam of the same name and the Atlantic-side locks are located. By the coming April the dam will be ready to hold 50 feet of water in check. Within 12 months thereafter it will be completed and ready for the maximum head of water, 87 feet. The work of the locks is being pushed forward so that they will be completed by the end of the calendar year, except for the installation of the operating machinery, and that will be completed five months later.

Passing through the locks, we next come to the channel through Gatun Lake. We find this now all but completed for a distance of 26 miles. By the first of May there will be nothing left to do with this stretch of more than half the total length of the canal but to put in the lighting equipment and other aids to navigation. Already the water is spreading over the bottom of the lower part of this section of the big waterway. Already Colonel Goethals is serving notice on the people who wish to see the canal while the magnitude of the work is still apparent that they had better visit the Isthmus soon. He says that belated visitors will wonder where all the work could have been done.

This 26-mile section carries us past Las Cascades and two miles into the great Culebra Cut. The next four miles represent the very backbone of the work yet to be done. In a comparatively few months there will be only about three miles of the cut above the requisite depth. Thirty steam shovels will be concentrated on that, and, if their present gait is maintained, within 16 months proud old Culebra Mountain no longer can bid defiance to the age-long desire of men for a shipway through its vitals.

The only thing that might possibly happen to delay this work further would be unexpected slides, but they are provided against from the fact that by that time the water in Culebra Cut will be deep enough to float the big 20-inch suction dredges, which would be brought up through the locks and set to work. Before them the slides would disappear as a snowbank on a balmy day.

Passing through Culebra Cut, we next come to the Pedro Miguel lock—called "Peter Magill" by the Americans on the Isthmus. Here the work is all but completed, except for the installation of the machinery, and that task is going forward in such a way that it will be in readiness before Culebra Cut is completed. The dam here—which is a small one, comparatively speaking—will be finished at an early date.

The next 2,000 yards or more of the canal will be a small lake between the single flight of locks at Pedro Miguel and the double flight at Miraflores. This lake, which will cover nearly 1,200 acres, will be finished by the end of the present year. After passing through this lake we come to the Miraflores locks, and such unusual progress has been made on them that, although the work could not begin on them until the Pedro Miguel locks were completed, the division engineer has announced that he expects to have the work on all the Pacific locks ready for the installation of the machinery before Thanksgiving Day. Already the contractors are putting in some of the gates and operating machinery.

After passing through the double flight of locks at Miraflores we find ourselves back at sea-level again. The dam connecting the Miraflores locks with the adjacent hills is not completed yet, and will not be until the early part of 1913, being kept open to let the dirt trains from Culebra Cut through on their way to the Naos Island dumps. Much of the material for this dam will be taken from the sea-level ditch from Miraflores to the sea. This portion of the canal will be completed fully 18 months ahead of the official opening day of the big waterway. Already it is open to navigation for more than five miles inland from deep water. Only three miles out of the eight still remain uncompleted.

This rapid passage through the canal demonstrates how fast it is nearing completion. The entire channel is a little more than 50 miles long. About 37 miles of it, including the lock sites, are now down to its requisite depth, and, of the remaining 13, there are less than eight miles of really heavy work.

THE PERMANENT FORCE

From all this it will be seen that the latest date set for the completion of any part of the work is July 1, 1913. The problems are now beginning to shift from the Canal Commission to Congress. That body will have a number of problems to solve, and, if the full fruitage of the magnificent performances at Panama is to be realized, prompt action is obviously essential.

The first thing to be determined is how the permanent operating force of the canal shall be made up. We now have on the Isthmus a body of 5,000 of the best Americans who ever trod shoe leather. They are the cream of a five-year-long process of elimination. It is the desire of the chief engineer that legislation be enacted at the earliest possible date permitting him to select from this force the 2,500 men who shall constitute the permanent force for the operation of the great waterway. Many of the best men, with the sort of foresight one would expect among such people, are already accepting offers from other sources, to take effect as soon as the canal is completed. Beginning next fall, hundreds of men will be laid off every month.

Colonel Goethals will recommend a new wage scale for the permanent body. He thinks that health conditions are now such that there will be no longer a necessity to maintain the present high standard of pay. The new scale will be about 25 per cent higher than in the United States, while all of the supplies the operatives and their families will use will be furnished by the government at cost.

Another question which must be decided is what form of government there shall be in the Canal Zone, and what shall be done with the people who live there and who will not have employment on the canal. It is pointed out that the land is practically unfit for agriculture, and that to leave the people there will necessitate the expenditure of millions of dollars for sanitation that might otherwise be saved, to say nothing of the danger that might arise from having aliens on the zone in case of war. If Congress follows the recommendations of the canal authorities, the zone, except for the terminal cities, will be depopulated, leaving only those who will be connected with the operation of the canal and its works.

FIXING THE TOLLS

The knottiest problem with which Congress will have to deal in placing the canal in operation will be that of fixing the tolls. Shall it be made free to American vessels, or only to such American vessels as are not engaged in coastwise trade? Shall it be toll-free to all ships of all nations? Shall the rate be made only such as will pay for the mere cost of operation, allowing nothing for interest on the investment or for the final return of the cost of construction? There are dozens of varying views on all of these matters.

The first feature of the whole proposition is the fact that when we have completed the canal we will have a possible ship-handling capacity of 80 million tons net register. This means that we can annually put over 200 million tons of cargo through the canal, since each net register ton of a ship, American measurement, means two and a half tons of ordinary cargo. Deducting for naval vessels and for light-loaded ships, and also for such as might go through in ballast, it is probable that the annual freight-carrying capacity of the canal will be upward of 125 million tons of actual cargo—enough to load a freight train reaching around the world. All hands realize that the more use of the canal the commercial interests of America make the more valuable will it become.

There are many who take the following view concerning the matter of tolls: If the United States is to make the most out of this great enterprise, the inland waterways of the country must be developed to the point where the Mississippi River, the Missouri River, the Ohio River, and other streams of the great Mississippi Valley shall be made navigable for ocean-going steamers, so that vessels may load direct and go to the ends of the earth. Then, the rivers to the Atlantic and Pacific seaboards ought to undergo similar development. To do these things would require a half billion dollars. Consequently, if the government should reimburse itself for the outlay for the construction of the Panama Canal, it would be in good shape to undertake inland-waterway development.

Those who subscribe to this view feel that a rate of toll can be fixed which would not discourage a ton of business from going through the canal, and yet which would serve ultimately to repay the cost of its construction. The rate which seems to meet with most favor is one dollar per net register ton. As explained before, the net register ton, American measurement, means two and a half tons of actual cargo. On that basis the rate per ton of cargo would, with the average cargo, amount to about 45 cents. Such a rate would be less than five per cent of the through rate from San Francisco to New York.

It is estimated that any rate above $1.40 per ton might drive business across the Isthmus of Tehuantepec, through the Straits of Magellan, or through the Suez Canal. The officials of the Tehuantepec route freely concede that if the rate is made as low as a dollar a ton they will have no chance at getting through-cargo business. They now get one-third of the through rate between San Francisco and New York, and between Hawaii and Atlantic seaboard points. What they are hoping for, however, is that there will result such a great boom in business upon the opening of the canal that they will gain enough distributing business to make up for their loss of through-cargo trade.

Suez will find Panama a great competitor with a rate of 45 cents per cargo ton. At Suez the Danube measurement is used, which allows only three-fifths as much space for a net register ton as does the American measurement. This results in the rates at Suez being fixed at practically 75 cents per cargo ton, or nearly double the proposed rate at Panama.

There are those who urge that the canal ought to be toll-free to all nations. They say this has been a great altruistic undertaking, and that our chief glory should be in making it usable without money or price by all the ships of all the seas. Those who oppose this idea say that the canal was built by Americans and for Americans, and that inasmuch as more than 50 per cent of the business which will pass through the canal will not touch our shores, there is no reason why it should be used to give Europe trade advantages to which we have fair title ourselves.

HANDLING SUPPLIES

It is the hope of the canal authorities that Congress will enact a law permitting the canal to furnish coal, ship-chandlery stores, and everything else that is needed by ships which would use the canal. They would not make it a government monopoly, but would leave others free to compete. The present laundry would be maintained, receiving a ship's laundry as soon as the vessel reached the canal, and delivering it back by the time the transit of the canal was finished. If authority is forthcoming, a commercial drydock will be maintained and large repair shops kept open.

One advantage vessels will have in passing through the Panama Canal is the fact that the 32-mile section between Gatun and Pedro Miguel will be filled entirely with fresh water, and that this will serve to remove the barnacles from the ships. Colonel Goethals says he expects the entire bottom of the canal to be paved with ships' barnacles in the years to come.

It is believed that the best possible way to encourage vessels to choose the Panama route is to have there at fair prices and in sufficient quantities everything that a ship thousands of knots from home may need. With the knowledge that such things may always be had and that prices will not be put up on any pleas of scarcity, the ships of the world could sail via Panama with a larger proportionate load of revenue-producing cargo than by any other route.

WORK AT GATUN

There is perhaps no other work on the whole canal more interesting than that at Gatun. Here it is that one gets a view of some of the most stupendous work on the great waterway. Gatun Dam is now taking shape and soon will be up to its full height. To the tourist it is a most disappointing sight. When he approaches Gatun he inquires where the dam is, for, be it said, the slope of the structure is so gentle that few people recognize it as a dam. Take a yard-stick and elevate one end three inches above the other, and you have about the average slope of the down-stream face of the dam. On the upstream side the slope would be represented, so far as the part under water is concerned, if you elevated the one end of your yard-stick four and a half inches higher than the other end.

The completed dam will cover some 400 acres of ground and will contain 21 million cubic yards of material—enough to make a wall of earth three feet high and three feet thick and reaching nearly half way around the world.

The dam has been full of surprises, but very different kinds of surprises from those which the pessimists were expecting. The site was for a long time called into question. When Colonel Goethals took charge he immediately put into effect a policy of not taking even the smallest thing for granted when he could prove a thing by actual test. After the assertion had been made thousands of times that there was an underground river flowing beneath the dam site, he honeycombed the whole area with borings and sunk a big shaft down to solid foundation, so that he could see with his own eyes. He found almost none of the conditions the fearful ones had pictured. But, in order to forestall all criticism, he planned the dam so as to include triple interlocking steel sheet piling across the valley, driven down to bed-rock, and a dam that should be 135 feet high—50 feet above the water level.

Then came the famous "collapse" of the dam, wired to the American press by a Panama newspaper reporter. People did not stop to think that there was as yet no dam there to collapse, and President Roosevelt was alarmed at the widespread uneasiness. It was this that led him to send the board of engineers to the Isthmus, accompanied by President-elect Taft.

The net result of the trip was that the engineers declared the dam was being built needlessly high, and that there was no occasion whatever for the use of the piling. So it was cut down to 115 feet, and the piling was omitted. After all, the story that shook the confidence of the American people in the dam bore good fruit in the resulting saving in the construction of that dam. The only

XUM

criticism of it today is that it is still larger than was necessary. Colonel Goethals admits that if he had been building it for private corporations he would have made it smaller. But "concede everything else to safety" has been his policy from beginning to end.

We see this same attitude in the matter of providing for the disposal of surplus water coming into Gatun Lake during the high stages of the Chagres River. The Gatun spillway is being built so that it can discharge 137,000 cubic feet of water a second, the water issuing at a speed of 35 feet a second.

This will take care of the maddest flood that history records in the Chagres. In addition to this, the big culverts of the locks can be turned open and a flood of 170,000 feet a second is provided for. Yet the Chagres can flow at its highest known stage into the Gatun Lake for 5½ hours, with no discharge at all, and raise its level only one foot, and can raise seven feet without doing damage.

In other words, although the Chagres could do its worst for a day and a half, without a drop of water going over the spillway, without doing any damage, the canal authorities have arranged to pass out more water per hour than the Chagres can possibly bring down, and have not presumed at all upon that day and a half advantage over the Chagres.

EVERY CONTINGENCY PROVIDED AGAINST

Still another incident serves to illustrate the wonderful care that has been taken uniformly not to draw a rosier picture than conditions warrant. Colonel Goethals always declared that the material which would constitute the hydraulic core of the dam would be sufficiently impervious to water to prevent any dangerous seepage. But experience is proving that there is no seepage at all. A long pond is maintained at all times on the crest of the dam, and into this the big dredges are pumping millions of gallons of water. The clay settles and part of the water runs off. The remainder stays there, seeking out every possible crack and crevice, a sort of hydraulic stone-mason, who tightens up every minute space and offers a perpetual guarantee that when he finishes his work all will evermore be well.

Another illustration, showing how more than cautious are the responsible heads of the canal in their efforts to insure its integrity, is the provision against accidents in the operation of the locks. The fact that they are, so to speak, "double-tracked," so that even if things should go wrong in the one set of locks, the other set will be available, is in itself regarded as practically eliminating danger. But this is only an incidental precautionary step.

In order to guard against danger from a ship ramming the upper or lower gates, there is a heavy chain stretched across the channel, with the ends attached to giant hydraulic paying-out machinery. These chains and their paying-out attachments are strong enough to stop a 10,000-ton steamer traveling at the rate of five knots an hour. But even if they should fail to bring a vessel to a stop and it should ram down the outer gates, there would still be a second pair of gates across the channel. Not once in millions of times would the first gates be rammed, and as for the next pair, it is almost beyond possibility that they should be reached by the vessel and forced open.

But suppose the chain failed to stop the ship, then that the outer gates also failed, and then even that the almost impossible should happen—the second pair of gates rammed; even that contingency is amply provided against. A large cantilever bridge will be ready at all times to be swung across the channel. From this there would be let down a series of nickel steel wicket girders into the madly rushing waters. The lower ends of these girders would engage a sort of offset in the lock floor, making a series of small, nearly perpendicular railways, on which large steel sheets mounted on rollers would be let down. By the time all of the girders and sheets of steel were in place, there would be an effective steel dam interposed to replace the damaged gates. Such an emergency dam is to be found at the Soo locks. Although it had grown so rusty by disuse that it could not be operated by power when an accident did happen, it was placed in position by hand and effectively served its purpose.

But even here the manifold precautions to make impossible serious accidents in lock operation do not stop. Statistics of lock canals show that perhaps 90 per cent of the accidents in lock operation arise from vessels entering and leaving locks under their own power. There seems to be an impossibility to get shipmasters to respond to every signal given exactly as given and at the instant given.

To secure the proper coördination between the ship itself and the lock machinery at Panama, it has been decided that no ship shall be allowed to negotiate the locks under its own power. Therefore a series of electric towing engines will be installed on the side walls of the locks. When a ship approaches, it will be brought to a standstill outside the locks. Then four of these towing engines will be attached to it by means of hawsers—two at the stem, to pull it into the locks, and two at the stern, to hold it back and to stop it at the proper time. No canal on earth now in operation has more than half as many precautions to insure successful operation as the Panama Canal will have.

REMARKABLE EFFICIENCY

One of the most remarkable phases of the work of building the Panama Canal has been the unparalleled development of engineering efficiency. For instance, the cost of steam-shovel operation has been cut from 11.5 cents a yard to 8.88 cents a yard. The cost of hauling away the spoil has been cut down from 18.54 cents a yard to 15.22 cents, although the distance of transportation has increased from 8 to 12 miles. A ton of dynamite has been made to do twice as much work in 1912 as it did in 1908. They save $50,000 a month by shaking their cement bags.

When Colonel Goethals took charge of the work at Panama the incessant and insistent demand of the people at home was that he should "make the dirt fly." He recognized that if the canal were to command the support and confidence of the people during its construction, "making the dirt fly" would have to be the first aim of the canal diggers; the cost of making it fly would have to become a secondary consideration. How well he succeeded is shown by the tremendous results of 1908—37 million cubic yards of material removed.

Thereafter one heard little talk about making the dirt fly, and the Commission was then able to bend their energies to the work of making it fly economically as well as to making it fly fast. A tightening-up process here, the elimination of lost motion there, the invention of some time-saving device at another place—all served to make the operations more economical and to save millions of dollars. So great has been the progress in developing efficiency on the Isthmus that they have cut the cost of excavation in Culebra Cut by more than one-third.

THE USE OF CONCRETE

Nowhere else in the world has there ever been such a vast amount of masonry constructed on any single engineering project as is being built in the locks and spillways of the Panama Canal. In times gone by the masonry of all great projects, like the Pyramids of ancient times and the Assuan Dam of today, was made of natural rock; at Panama they make artificial rock, and make it so fast that one scarcely can believe his eyes. The concrete required on the whole project amounts to more than four and a half million cubic yards.

This is enough to build up an airline street from New York to Washington, with six-room houses on both sides. Those houses would furnish shelter for a population the size of the city of Indianapolis, taking the census returns of the number of people to the average American dwelling as the basis.

Expressing the magnitude of the project in another way, it would make a regulation sidewalk nine feet wide by six inches thick, reaching more than twice around the earth.

The locks at Gatun require two million cubic yards of concrete. Those on the Pacific side, being built with two flights at one place and the third at another place, require nearly 200,000 yards more

XUM

than the single triple flight at Gatun. The Gatun spillway claims approximately a quarter of a million yards.

Nowhere else in the world does one get a more vivid impression of the versatility of concrete than on the Panama Canal. They are using it to make the giant locks, and with equal success in constructing the huge piers and docks at the ends of the big waterway. They have been trying out a cement gun to shoot cement—sand and water, mixed as it passes out of the nozzle—against the sides of the Culebra Cut, to form a coating of solid artificial rock, although the experiment has not proved as much of a success as had been hoped. They are building light-houses and other aids to navigation out of concrete, and have even gone so far as to build barges of this material.

Nowhere else in the world is there to be found such extensive concrete mixing plants or such remarkable machinery for handling the material. Millions of barrels of cement had to be carried to the Isthmus and millions of yards of stone had to be quarried and crushed at Ancon and Porto Bello. Sand by the hundreds of barge-loads had to be brought from islands in the Atlantic and the Pacific to keep filled the seemingly insatiable maws of dozens of giant mixers, which receive some ten tons of sand, cement, crushed stone, and water, whirl them around for a minute in a sort of digestive process, and then dump the mass out in the shape of unhardened artificial stone.

Many new problems in concrete construction have been worked out at Panama. The effect of sea water on concrete, the time of setting for such huge masses, and a dozen other matters, upon which depended the stability of the locks and the integrity of the waterway, had to be met. All of them were met in the spirit of accepting nothing as proven until it was proven by actual physical test.

The world is now in the age of concrete, and the Panama Canal must go down into history as the greatest effort man ever has made and perhaps ever will make to simulate the processes of geologic ages and do in days what nature required unreckoned years to accomplish.

HEALTH CONDITIONS

Turning now from the engineering features of the canal to the other phases of the work, we find that here equally remarkable conditions prevail. While we are building a 40-foot canal in less time than it took the French to discover that they could not build a 15-foot waterway, and are making it a glorious success with no greater outlay than it required for the French to make the most dismal of failures, it is largely because extravagance and disease conspired against the French as they never did before or since against any people. They actually had brought over snow-shovels, for what no mortal man knoweth, and they also were supplied with thousands of torch-lights for the celebration procession. Fine motor-boats were shipped to Culebra in anticipation of the day when water would be running into the canal.

But then the French did not know about the yellow-fever mosquito. They actually made things easier for their tiny but most deadly foe. They set the posts of their hospital beds in little pans of water to keep the ants away—and the yellow-fever mosquito reveled in it.

When we went to Panama we had learned the secret that the mosquito had kept hidden from humanity for all the generations before. If the Spanish-American War had taught the necessity of the Panama Canal, it also furnished the lesson which made the work possible. The lessons of sanitation at Havana, and the making out of a complete case against the yellow-fever mosquito by Drs. Reed, Carroll, and Lazear, put into practice by so able a sanitarian as Dr. Gorgas, at Panama, has served to make the Isthmus almost a tropical health resort.

When it is considered that the proportion of colored population on the Isthmus to the white population is larger than obtains in any American city, and that in spite of this the Canal Zone death rate is as small as that of the most healthful of American cities, the success of the sanitary campaign becomes remarkable.

Of course there is no region on earth where so much money is spent in proportion to population or to area for keeping the people in health as at Panama. Did we spend as much at home for sanitation and hospitals in proportion to population as we spend at Panama, our total outlay for health would aggregate one-third of all the expenditures of public money by the United States, the States, the counties, municipalities, and school and road districts of the country combined. Did we spend as much in proportion to area, our total outlay for health purposes would amount practically to 12 billion dollars a year.

It has been said that there might be both a congress of nations and a congress of mosquitoes on the Isthmus. Counting the islands of the sea as separate countries, it is said that there are 52 countries represented on the Isthmus, and the number of kinds of mosquitoes once was many times more.

But the mosquito cannot operate successfully in oil stocks; water is his line. A baby mosquito must live in the water, and is under the necessity of making some 8,000 trips to the surface while growing to adulthood. It comes up for air. If it happens to get a single speck of oil down its little gullet on any one of these many trips, there is a funeral in mosquitodom soon thereafter; and thousands of barrels of oil have been scattered upon the mosquito-troubled waters of Panama. Doing this, keeping the grass cut, the drains all open, and dangerous diseases out of the ports represents a large proportion of the health work at Panama.

THE MAN AT THE HELM

When President Roosevelt called upon Lieut. Col. George W. Goethals to go to Panama and dig the canal, he selected a leader of men who is entitled to rank with the greatest captains of history. To study him at close range is to know one of the most remarkable men of the times. He cares just about as little for popular applause as any man I have ever known. He always keeps himself in the background. Tall, broad-shouldered, bronzed-faced, with snowy white hair and mustache, he is physically a man among men. Intensely loyal to his military training, he cares as little for its fuss and feathers and trappings as did Grant or Stonewall Jackson.

One day I was traveling with him across the Isthmus to Colon, and I remarked that he must be the busiest man on the Isthmus, and that yet I had never seen a man who always seemed to have as little pressing work before him. "I have a contempt for the man who is always trying to make it appear that he is busier than other people, and that they must wait on him," came the laconic reply.

At another time I remarked that he seemed to have solved all of the problems of the canal and had the whole force in smooth working order. "If you were to drop into my office any Sunday morning, when it is open to the lowest workman on the canal, you might think differently," he responded. "I think," he continued, "that the best way to keep men contented is to give them a hearing. I may not be able to do what they would wish, but the very fact that I hear them makes them feel that I want to do the right thing by them."

In speaking of the progress of the work in Culebra Cut, the Chief Engineer revealed to me a species of greatness above anything I have ever seen. He has worked and slept with his task for five years, keeping at it with unrelenting zeal and calm enthusiasm. The whole world rightly gives him great credit, but in one generous handful he turned the bulk of it over to his predecessor, doing it in about the following words: "The people talk about the success of the army engineer at Panama, but it was fortunate that Mr. Stevens preceded us. The real problem of digging the canal has been the disposal of the spoil, and no army engineer in America could have laid out the transportation scheme as Mr. Stevens did. We are building on the foundations he laid, and the world cannot give him too much credit."

Colonel Goethals has special trains, private cars, and motor cars at his disposal all the time, but as a rule he rides on the regular trains, in the ordinary day coaches, and goes about among the men on the work, keeping in touch with them at all times.

HUMORS OF CANAL BUILDING

Not everything is grim and determined work at Panama. A little fun now and then crops out, mostly imported from the States, and being brought by Congressional delegations who visit the canal. A year or two ago a Western Senator was in one of these delegations, and at a hearing on the Gatun Dam he inquired: "Colonel, how is it that so small a body of earth as the Gatun Dam can hold in check such a tremendous body of water as the Gatun Lake?"

Colonel Goethals replied that it was explained by that well-known principle of hydrostatics under which the pressure of a body of water is determined entirely by its height and not by its volume. Still the Senator could not see it.

Then Senator Knox, now Secretary of State, addressed the Western Senator, saying, "Senator, if your theory were true, how could the dikes of Holland hold in check the Atlantic Ocean?" Thereupon the Western Senator saw the point and joined in the laugh at his own expense.

Another distinguished visitor, traveling on a train which had just backed off of the Panama railroad on to the relocated line, wanted to know of the Chief Engineer if the relocated line were the same gauge as the other.

A young man in the diplomatic service of the United States, after having witnessed the putting of a model of the *Olympic* through a model of the Pedro Miguel lock, asked Designing Engineer Cornish how it was that they got the water into the locks without pumping it in.

There is a perennial circus on the Isthmus in the shape of the 30,000 West Indian negroes who are helping dig the canal. I have the word of the Chief Engineer that one of them has frequently been seen to go to the post-office, get a letter, place it on his head, put a stone upon the letter, and walk away. Upon one occasion three Martinique negroes were set to removing material with a wheelbarrow. They loaded it, and then one stooped down, the other two lifted it to his head, and he walked away with the load.

When one reflects that the 30,000 or more negroes and Spaniards who make up the common labor on the canal were all untrained and undisciplined, and that the force of negroes charges almost every year, it becomes all the more remarkable that such great feats of engineering performance should be possible at Panama.

SEA-LEVEL CANAL IMPOSSIBLE

As one who originally believed that a sea-level canal should be built, I freely acknowledge my belief today that if we had undertaken such a waterway, we would have retired defeated and disappointed, as did the French. The work on the present project has absolutely vindicated the judgment of those who opposed a sea-level canal. In the first place, the width of the waterway perforce would have been so narrow that it could readily have been blocked by some future Hobson with a *Merrimac*. In the second place, only God knows how much material would have had to be taken out of Culebra Mountain before its sides would have stopped slipping into the cut. In the third place, there would have had to be tidal locks, which would have been in more danger of being put out of commission than the present ones. In the fourth place, there would have had to be a higher dam at Gamboa than there is at Gatun, and a fairer mark it would have been for the aëroplane. No one ever leaves the Isthmus now without registering a vow of thankfulness for the wise course that was pursued in making it a lock canal. It is so obvious that the veriest layman can see it.

FORTIFICATIONS

With the two great forts at the two ends of the canal fitted out with four 14-inch guns, six 6-inch guns, and twelve 12-inch mortars, with twelve companies of coast artillery, one battery of field artillery, four regiments of infantry, and one squad of cavalry, there is not likely to arise a time when these fortifications, backed up by the American navy, will fail to command a proper and wholesome respect from other nations.

It is rather remarkable that the only objections that have been raised to fortifying the canal have come from our own people. To have made it neutral would have placed the United States in a peculiar position in case of war. Either we would have had to refrain from using it for our war ships, or else we would have had to permit the enemy to use it on equal terms. That would have meant that good American citizens, operating the canal, might have been forced to put the enemy's fleet through the waterway—practically compelled to commit a sort of legalized treason against their own government by giving aid and comfort to the enemy.

A NEW COMMERCIAL MAP

As intimated in the beginning, wonderful and world-affecting results must grow out of the completion of the canal. Cities that are today the way stations on the international routes of trade will grow up into veritable metropolitan communities. Other cities which are supreme today may fall back into second place a generation hence. When the Turks captured Constantinople and cut off the trade between the Orient and the Occident, Columbus sailed in search of a new passage to India and discovered a new world. When the Panama Canal is completed and the generation passed during which the highways of the oceans will be changed, the United States will have discovered a new world of international trade, which will so link and bind the nations together that the great waterway, built primarily for defense, will become one of the greatest factors in the promotion of universal peace, and the prophecy about swords being beaten into plowshares and spears into pruning-hooks will have been brought nearer to fulfillment.

AMUNDSEN'S ATTAINMENT OF THE SOUTH POLE

THIS page was already on the press when the cable came from New Zealand announcing the attainment of the South Pole by Roald Amundsen, December 14-17, 1911. Amundsen is a gold medalist of the National Geographic Society, having been awarded the Hubbard Medal of the Society for his achievement of the Northwest Passage from the Atlantic to the Pacific, and for his explorations and observations on that remarkable voyage of discovery. The Society rejoices at his well-earned success in attaining the coveted goal at the far South.

Many geographers had feared that Amundsen would yield to the temptation of following, for a considerable part of the way to the South Pole, the route previously discovered and opened by Shackleton; but his account shows that he was not satisfied to do this, and in consequence he has made discoveries and surveys that are entirely new.

The whole distance traversed by him—approximately 700 miles from his base, where he moored his ship to ice-front—to the pole itself, appears to have been across previously untraversed and unknown ice and land. He has defined the eastern and southern boundaries of the Great Ice Barrier, that vast plain of floating ice which flows down from the great Antarctic Continent, and whose western boundary had been defined previously by Shackleton. This enormous glacial ice plain is one of the wonders of the world. It is a solid mass of ice, floating for the most part, approximately 800 to 1,600 feet thick, and covering an area of about 100,000 square miles, or considerably larger than New York, Massachusetts, New Hampshire, and Vermont combined.

Amundsen found traveling across the barrier comparatively easy. He marched 382 geographical miles due south across the plain until he was confronted by the

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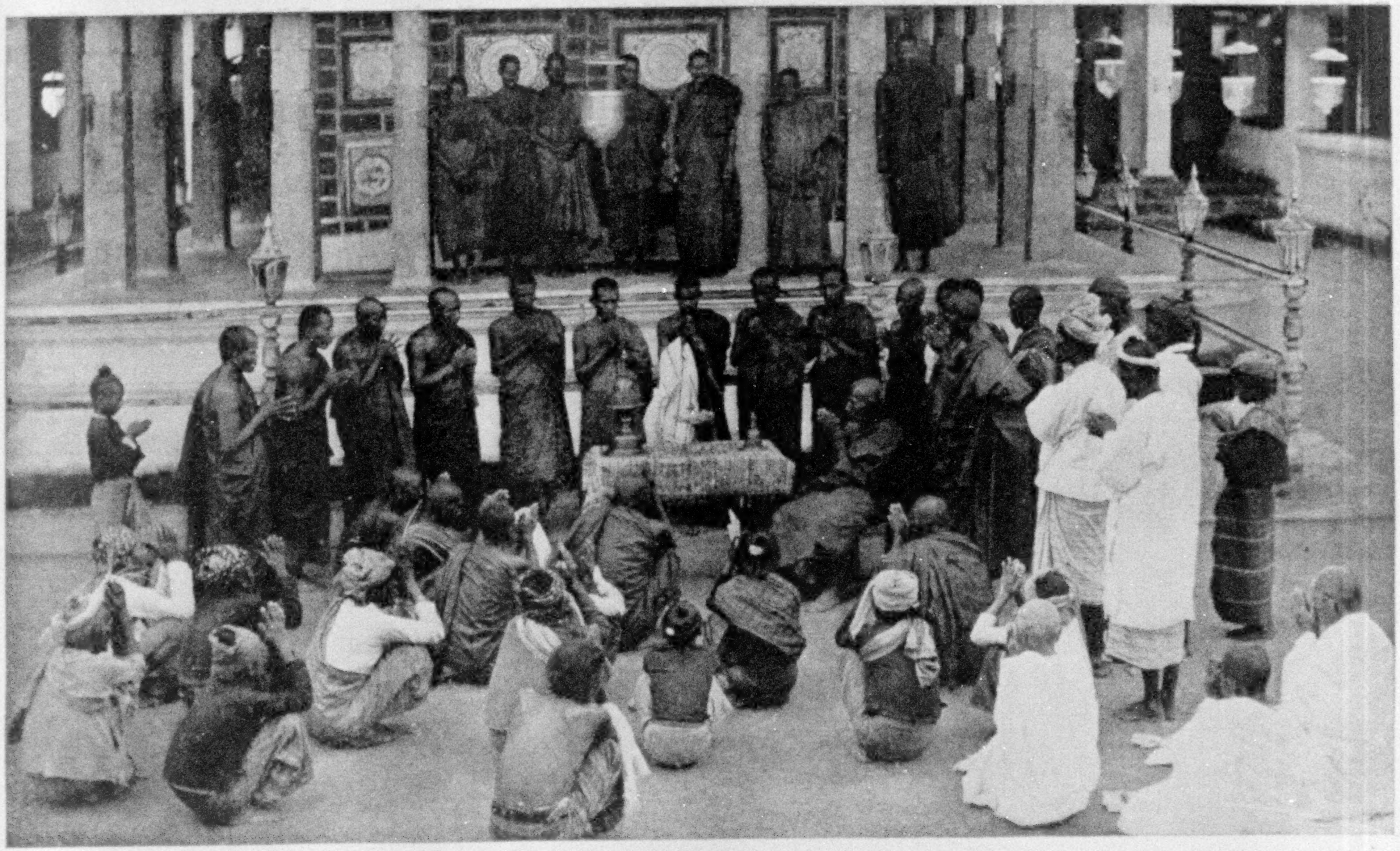
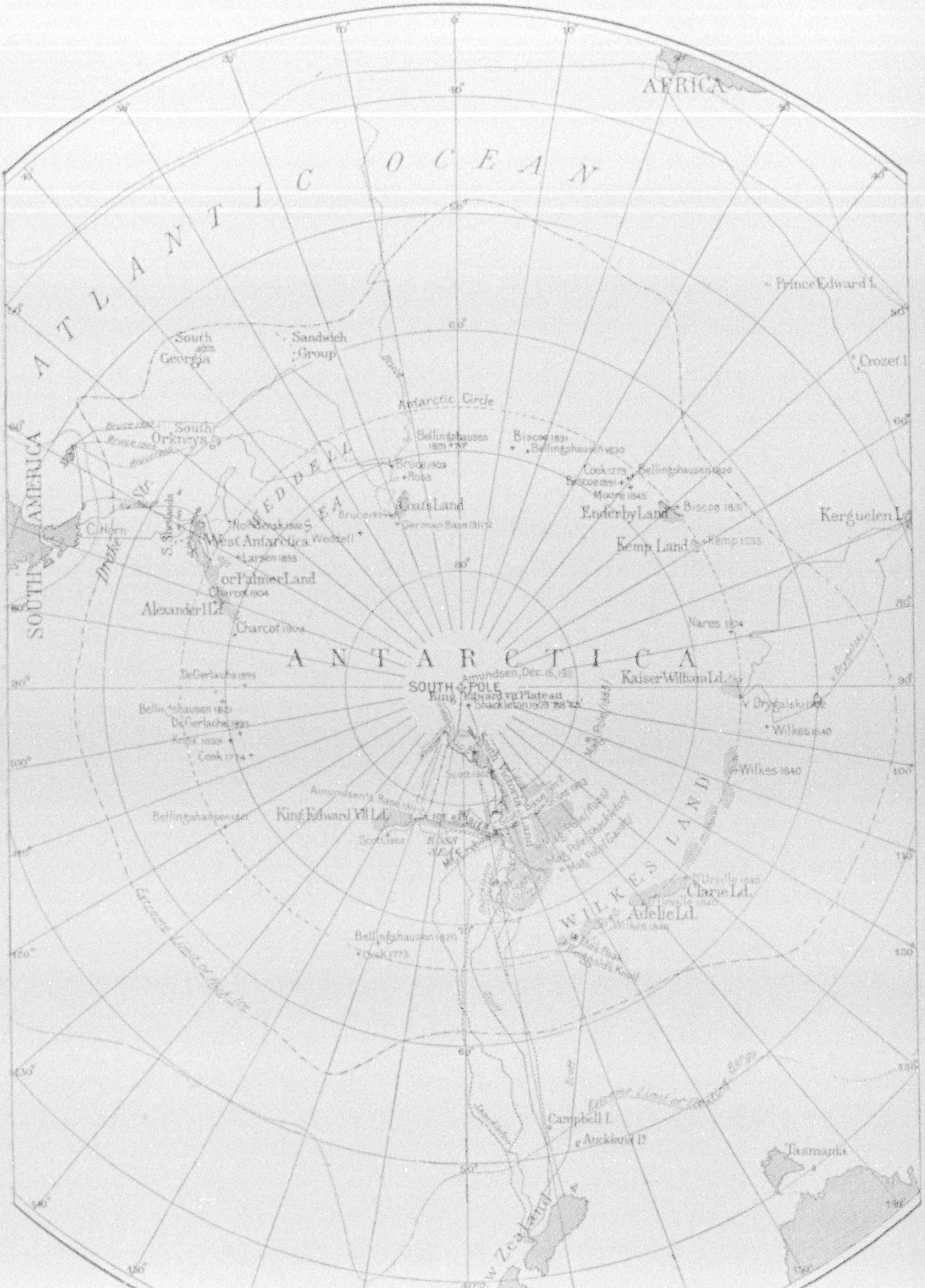


Photo from Eliza R. Scidmore

A SPECIAL EXHIBITION OF THE SACRED TOOTH: KANDY, CEYLON

The Sacred Tooth (of Buddha) was brought to Ceylon from India by a princess and enshrined in a palace of its own. It was carried off as loot by one of the Malabar raiders of Ceylon ten centuries later, recaptured and returned to Ceylon, and treasured in a hidden shrine until 1560, when the Portuguese took it and carried it to India, where they burned it with great pomp and threw the ashes into the sea. The King of Kandy thereupon had a new tooth, 3 inches long, made of choicest ivory, and enshrined in the place of the lost one. The new tooth is shown in this picture (see pages 117, 150, and 151).


AFRICA
ATLANTIC OCEAN
Prince Edward I.
Crozet I.
South Georgia
Sandwich Group
Antarctic Circle
South Orkneys
WEDDELL SEA
SOUTH AMERICA
C. Horn
Drake Str.
S. Shetlands
West Antarctica or Palmer Land
Alexander I Ld.
Charcot 1904
Coats Land
German Base 1911-2
Bruce 1903
Enderby Land
Kemp Land
Kerguelen I.
Biscoe 1831
Bellingshausen 1820
Cook 1773
Nares 1874
ANTARCTICA
SOUTH POLE
Amundsen, Dec. 15, 1911
King Edward VII Plateau
Shackleton 1909 88°23'
Kaiser Wilhelm Ld.
Drygalski 1902
Wilkes 1840
De Gerlache 1899
Knox 1839
Cook 1774
Scott 1903
South Victoria Land
Amundsen's Base 1911-2
King Edward VII Ld.
Scott 1902
ROSS SEA
Mt. Erebus
Mag. Pole (Ross)
Mag. Pole (Shackleton)
Mag. Pole (Gauss)
WILKES LAND
Clarie Ld.
Adelie Ld.
D'Urville 1840
Balleny Is.
Extreme Limit of Pack Ice
Extreme Limit of Floating Bergs
Campbell I.
Auckland I's.
Tasmania
New Zealand

OUTLINE MAP SHOWING ROUTE OF AMUNDSEN TO SOUTH POLE

Captain Scott's base is also shown. Scott was planning to follow the route of Shackleton. The Japanese South Polar expedition is now camped near Amundsen's base; the Australian expedition has made a base on Clarie Land; the base of the German expedition is on the other side of the continent on Coats Land.

high mountains. Here he was so fortunate as to find a glacier route up to the inland plateau easier than the Beardmore Glacier, which was used by Shackleton to ascend to the inland plateau three years before.

Amundsen and four companions accomplished the ascent from the ice plain to the plateau, 10,500 feet, in the marvelously short time of four days. He was now about 275 miles from the pole, and thence onward his greatest difficulties were encountered. The rare atmosphere at this high elevation made breathing difficult. Storms delayed them, but they pushed on and reached the pole December 14, staying there for three days. The pole is at an elevation of 10,500 feet. Amundsen reports a lofty chain of mountains, some attaining 15,000 feet, extending southeastward as far as he could see. The chain is probably an extension of the lofty range seen by Shackleton, and probably stretches across the South Polar area to Waddell Sea.

Shackleton in 1909 reached a point so near the South Pole that we have known pretty accurately the conditions at that extreme point, so that the part of Amundsen's narrative dealing with the pole itself, while highly entertaining, is not so important or so novel as it would otherwise have been.

Amundsen owes his success to his very carefully prepared equipment, to his splendid dogs and his skill in handling them, and to many years of previous experience in battling with the ice and snow of the far North. Next to Peary, he is the most experienced traveler on ice in the world. The following notes from his cable to the New York *Times*, to whom the world is indebted for his story, illustrate the minute care with which every detail was anticipated:

"Washing was a luxury never indulged in on the journey, nor was there any shaving; but, as the beard has to be kept short, to prevent ice accumulating from one's breath, a beard-cutting machine which we had taken along proved invaluable. Another article taken was a tooth extractor, and this also proved valuable, for one man had a tooth which became so bad that it was absolutely essential that it should be pulled out, and this could hardly have been done without a proper instrument.

"For food we relied entirely on pemmican, biscuits, chocolate, powdered milk, and, of course, dog meat. The dogs were fed on pemmican.

"In my opinion we had the best and most satisfying provisions possible. In fact, from the beginning to the end of the journey we never felt an undue craving for something to eat or any feeling of not having had sufficient nourishment."

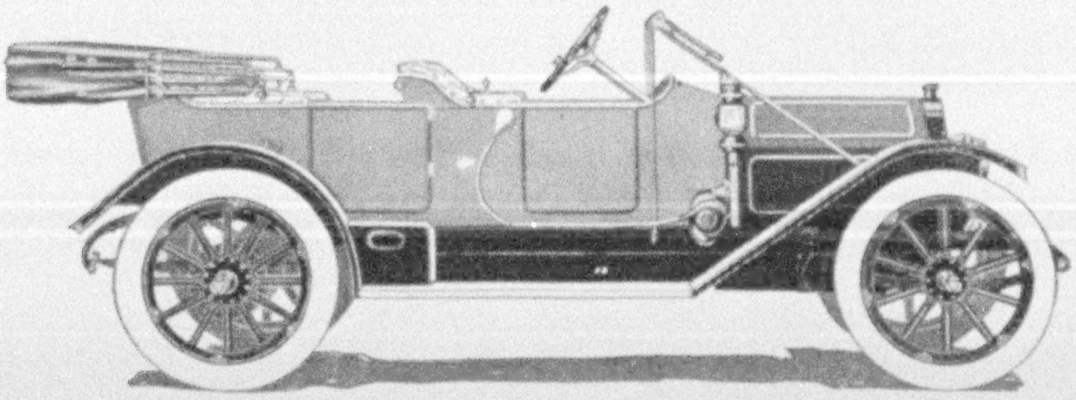
BIRD'S-EYE VIEW OF PANAMA CANAL

A GRAPHIC picture of the entire Panama Canal is given in the "Bird's-eye View of the Panama Canal," published as a supplement to this number of the Magazine. The great features which make the canal so remarkable—the giant Gatun Dam and spillway, the enormous cut at Culebra, the big artificial lake which forms about one-half of the canal route, and the long double locks—are presented so clearly that the reader vividly realizes the entire work. For the convenience of the readers of the Magazine, a limited edition of the map has been printed on heavy stock suitable for framing, and may be obtained at the offices of the Society for 50 cents per copy.

IMPORTANT NOTICE

THE very great popularity of the Magazine during the last several months, which has necessitated increasing the edition by more than 50 per cent, delayed the publication of the January and February numbers. The March number will follow very quickly, and we hope soon to catch up with the calendar.

The March number of the Magazine will contain a comprehensive map of China and its territories, 18½ x 21 inches.



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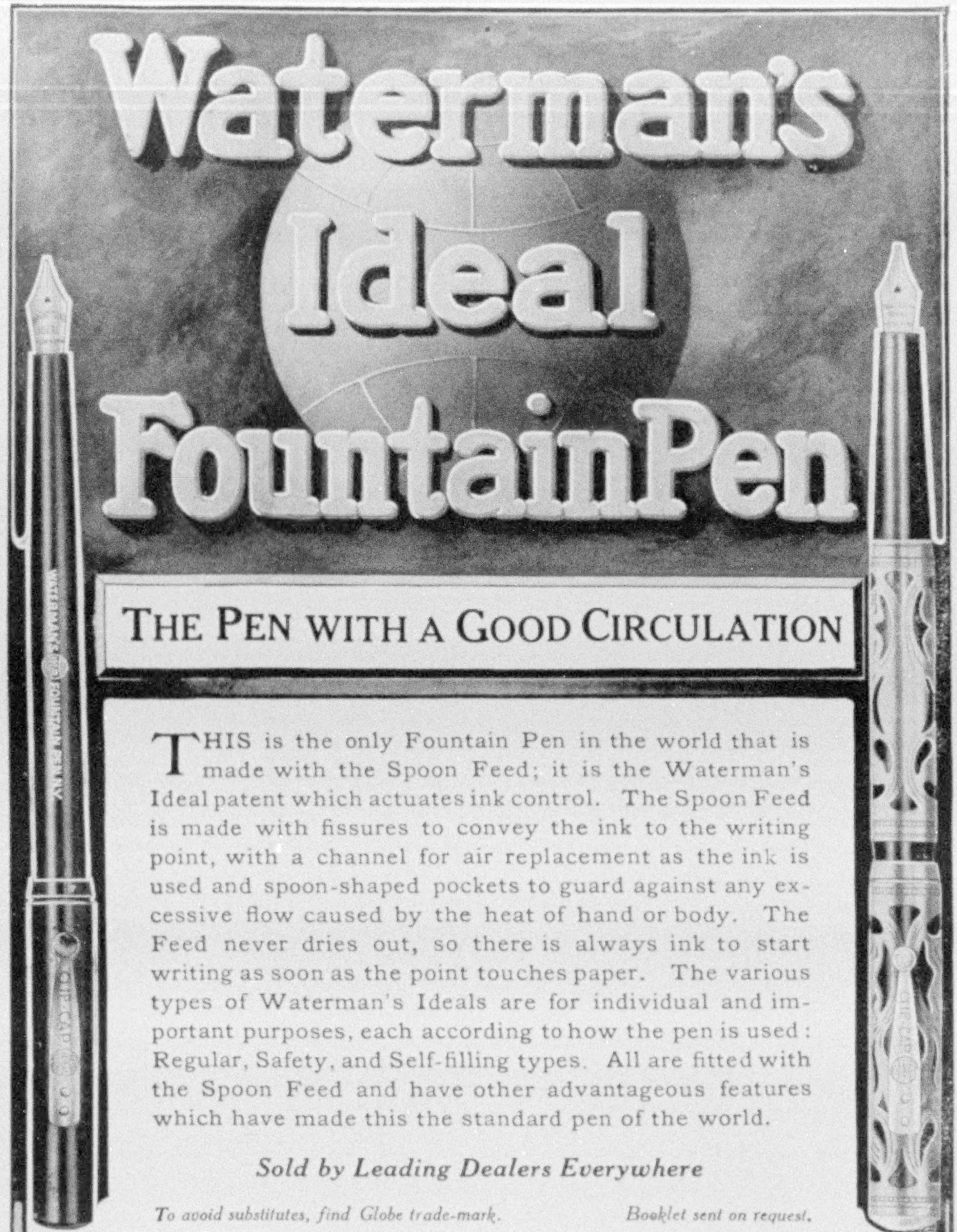
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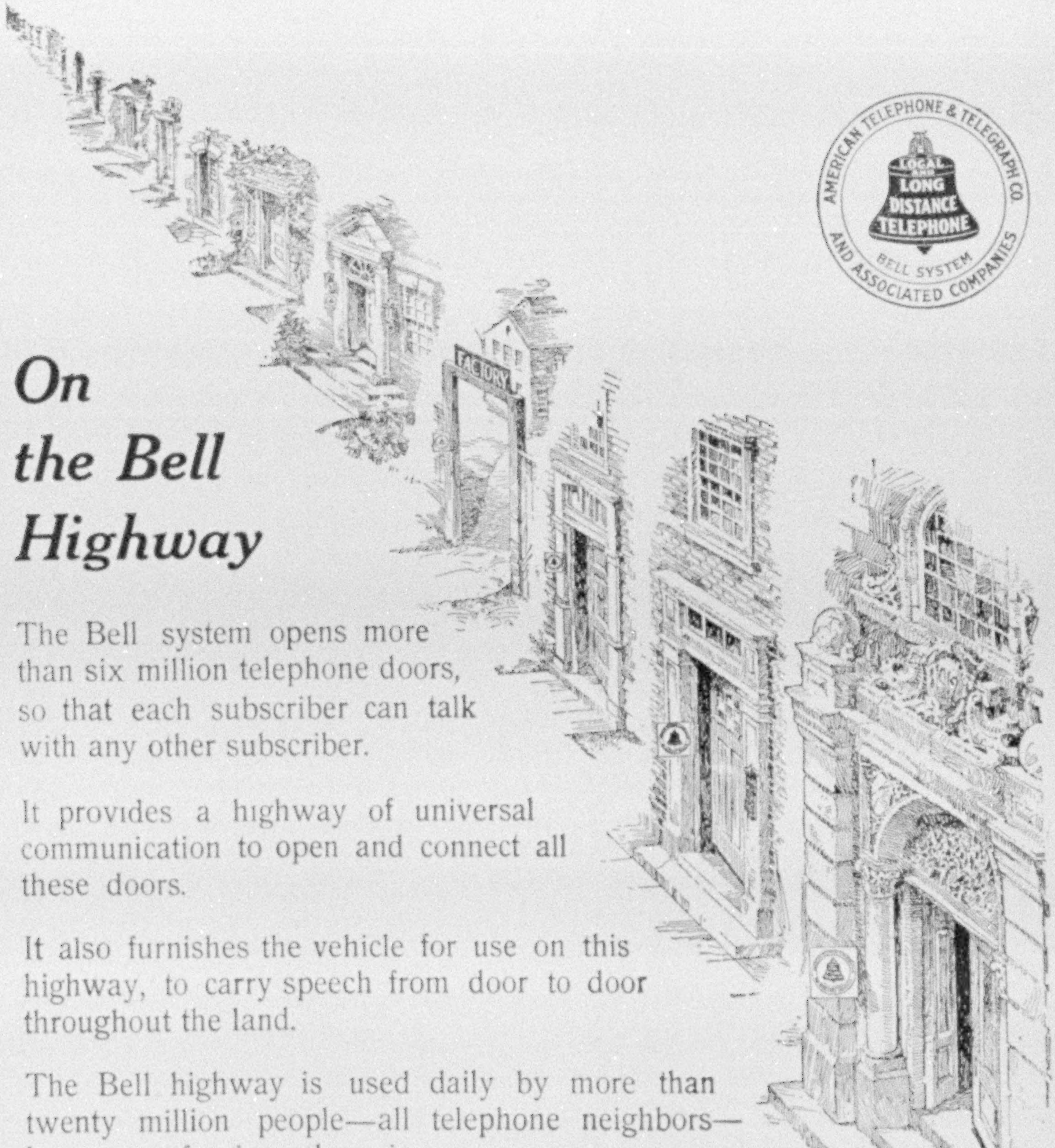

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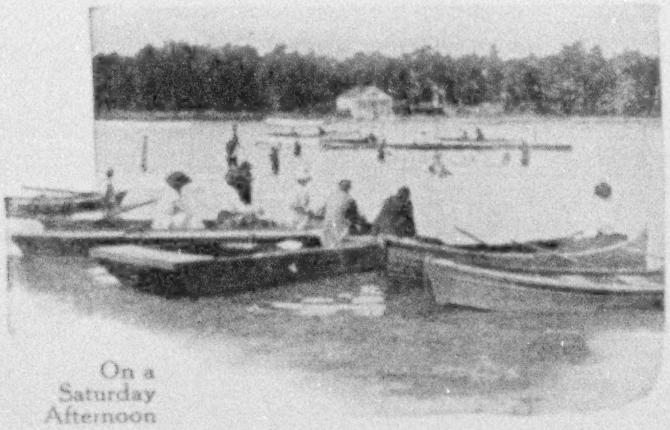

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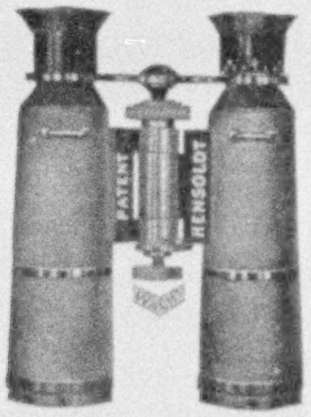

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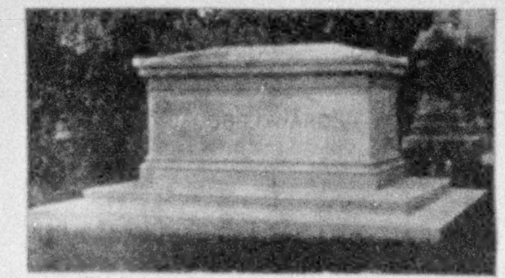

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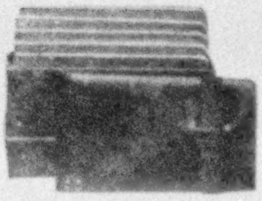

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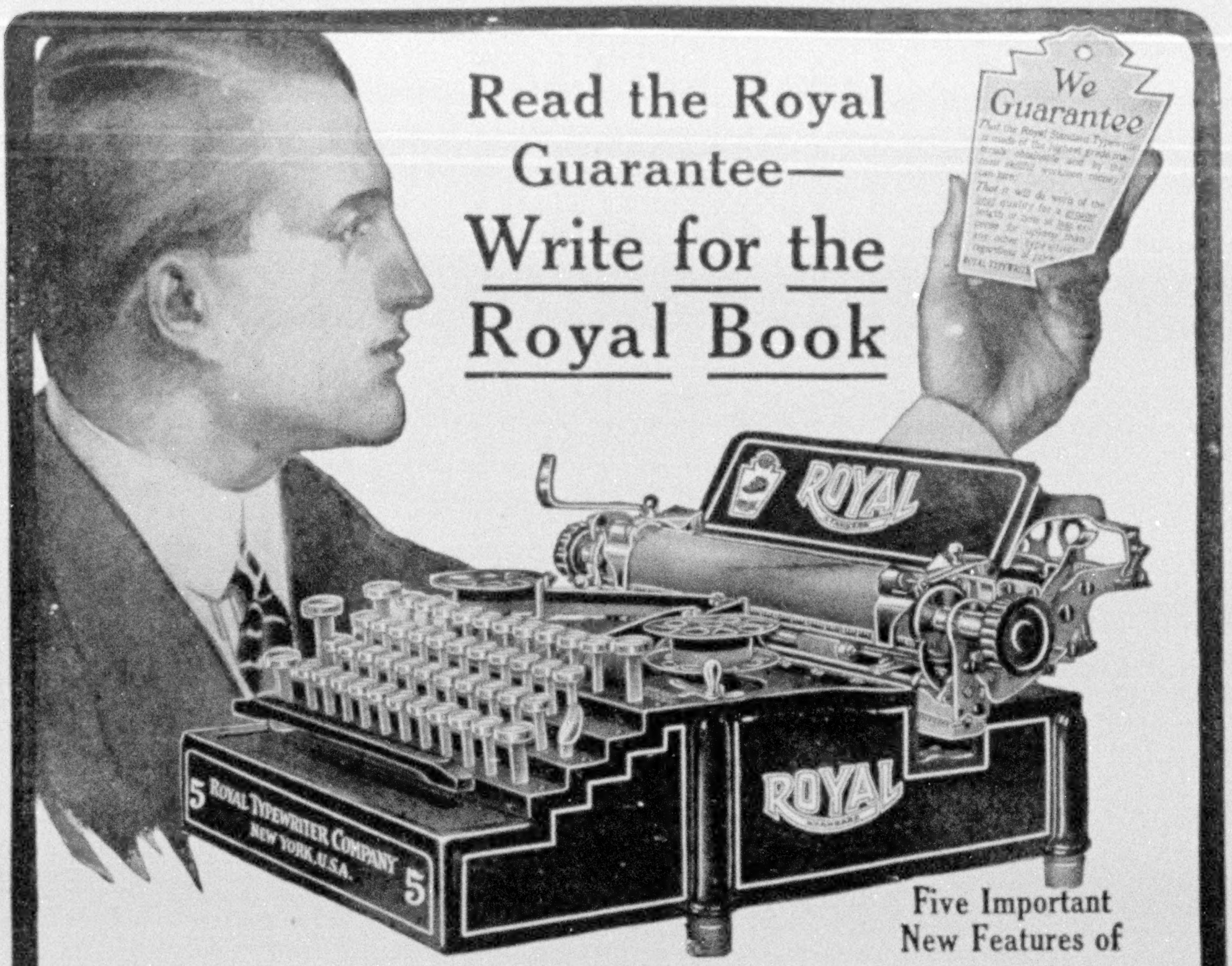
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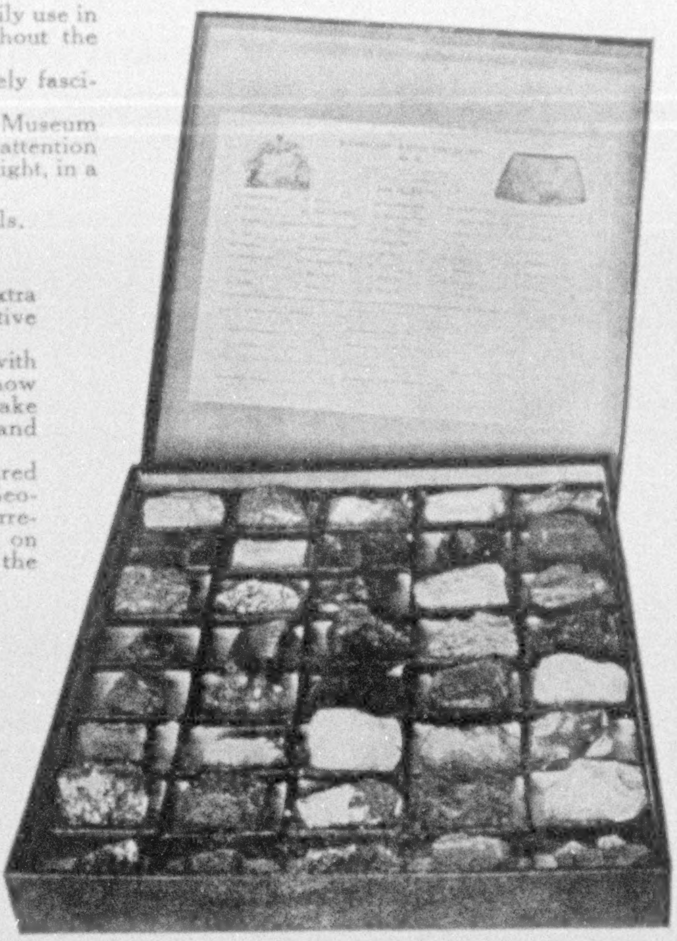

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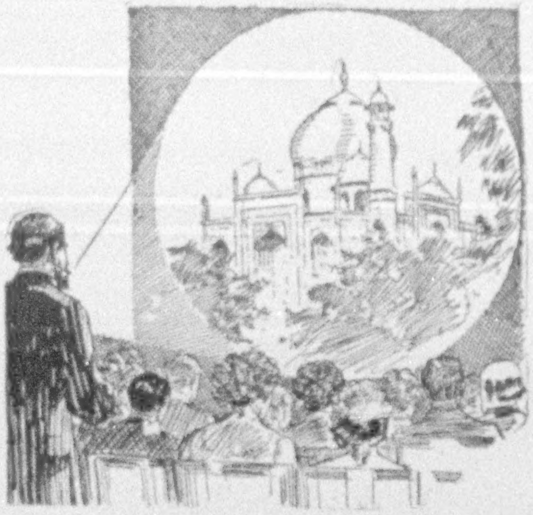

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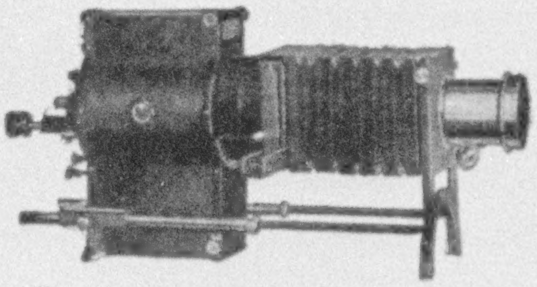

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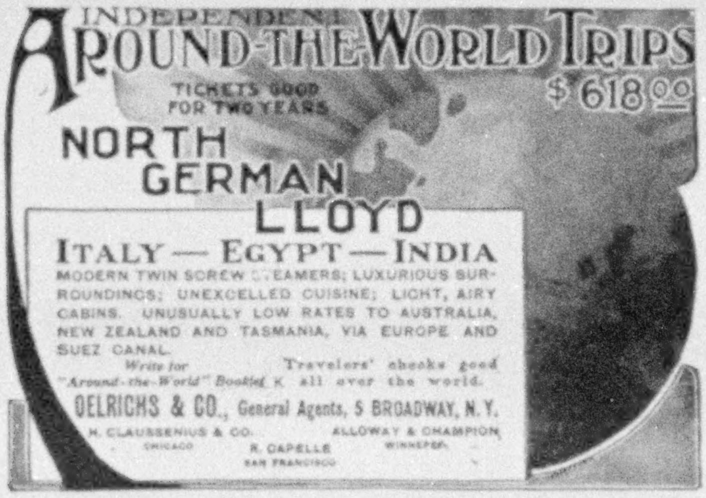

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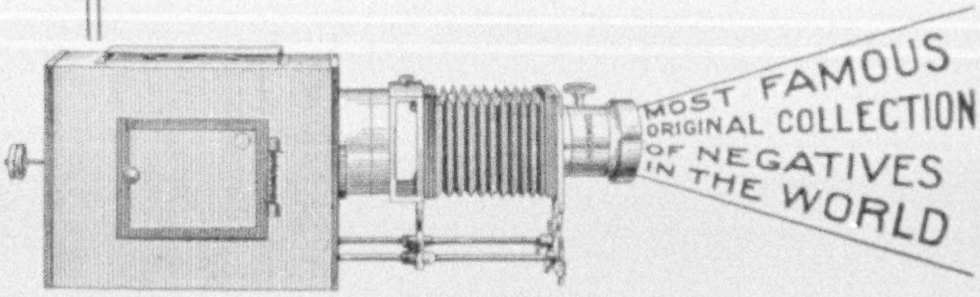

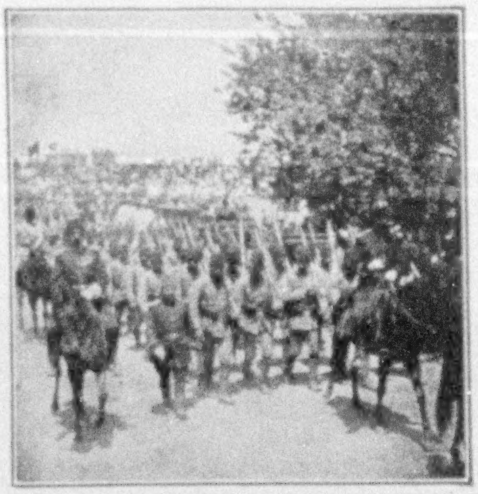

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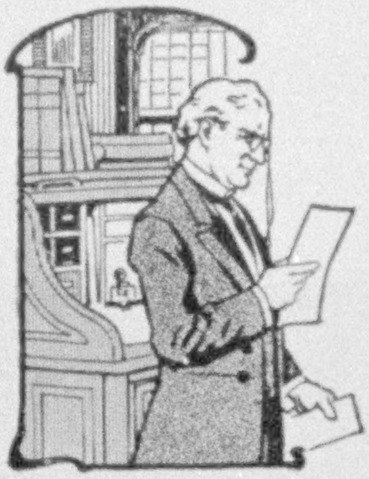

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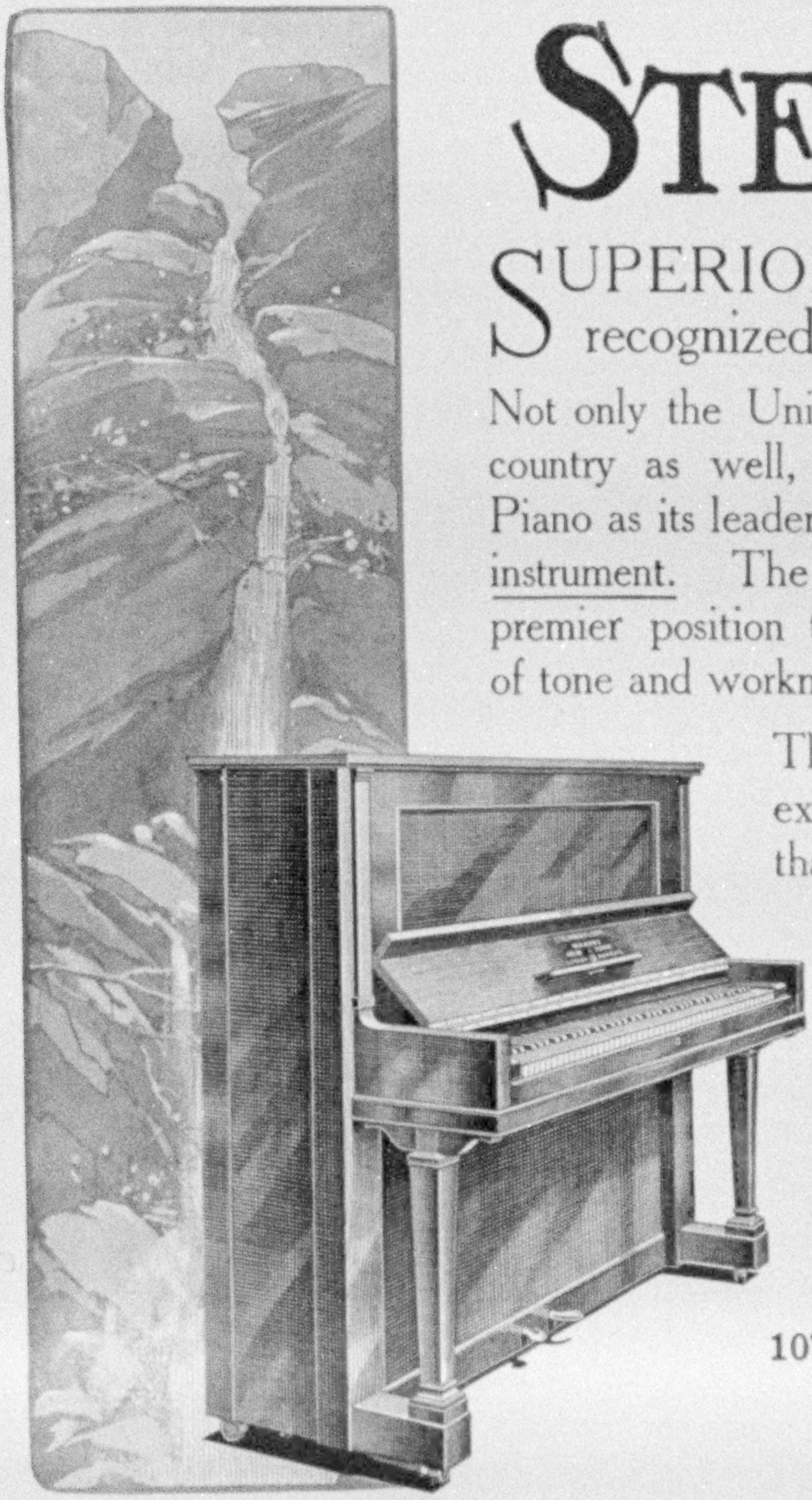

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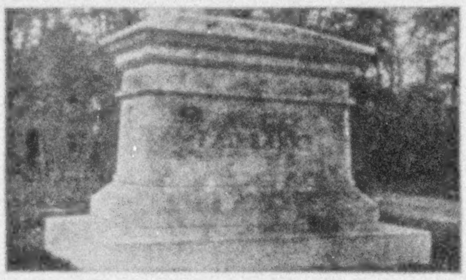

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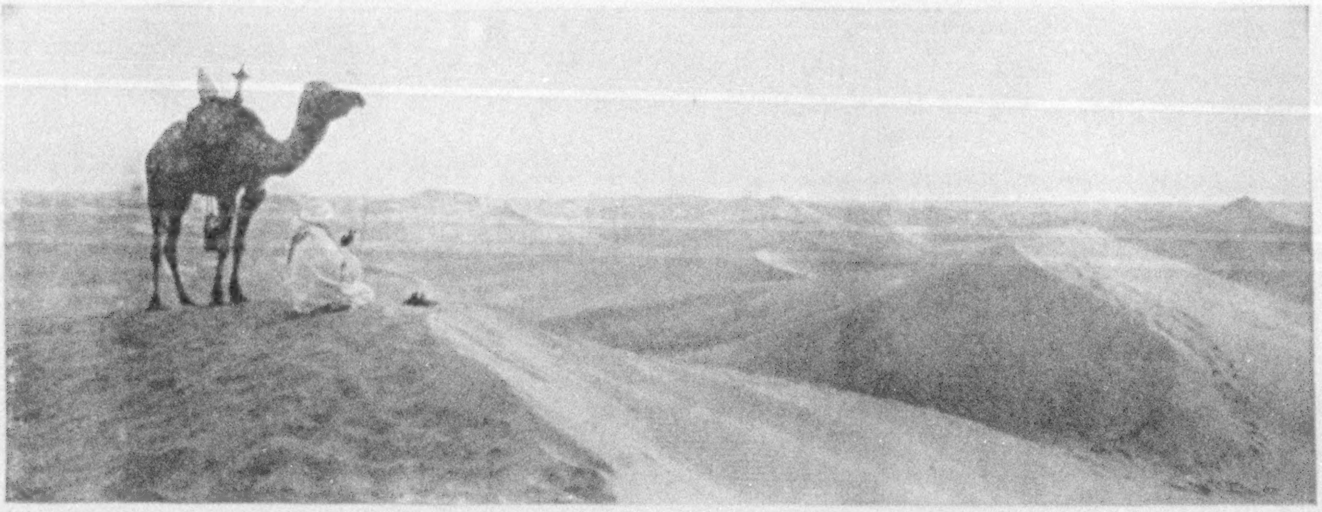

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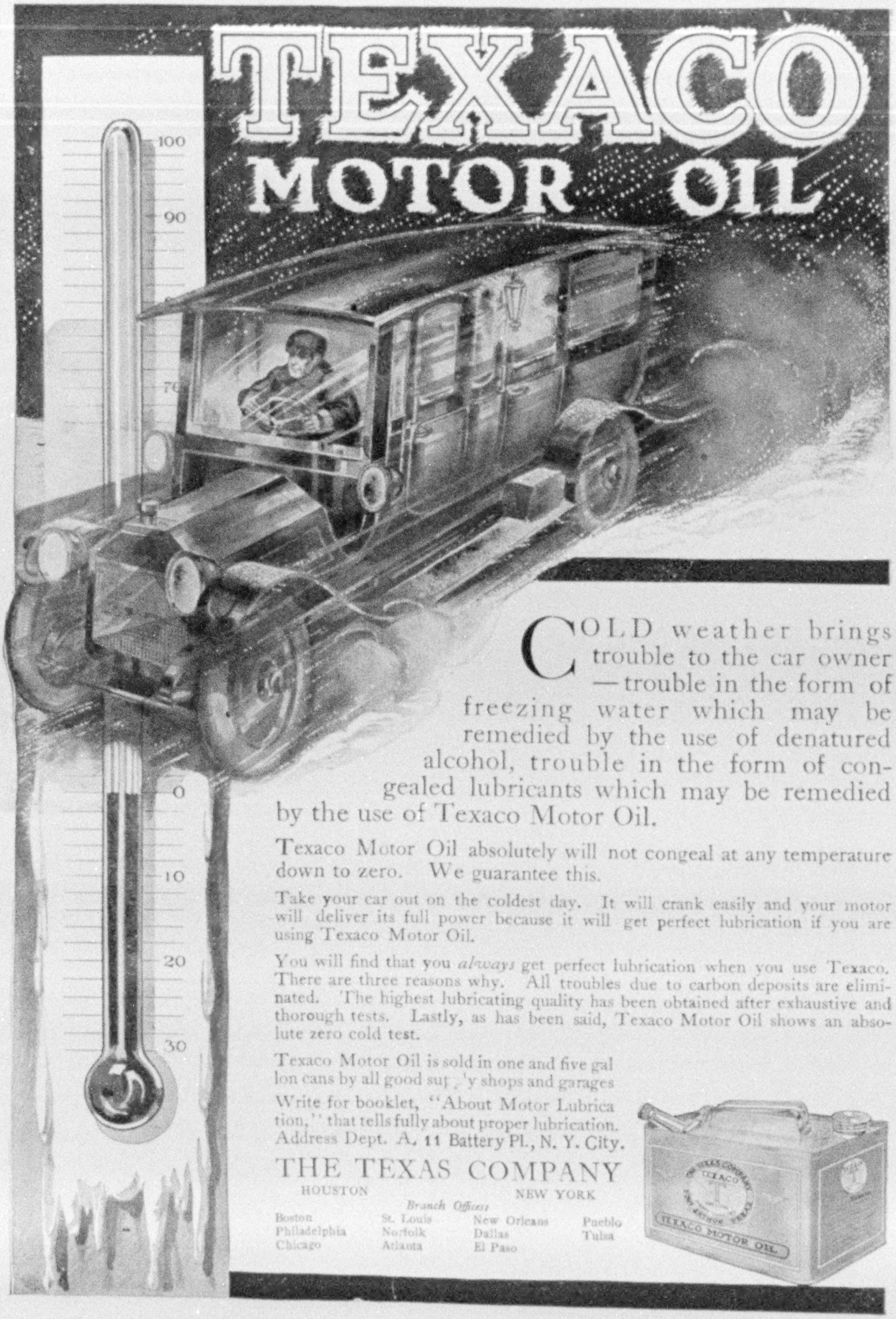

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